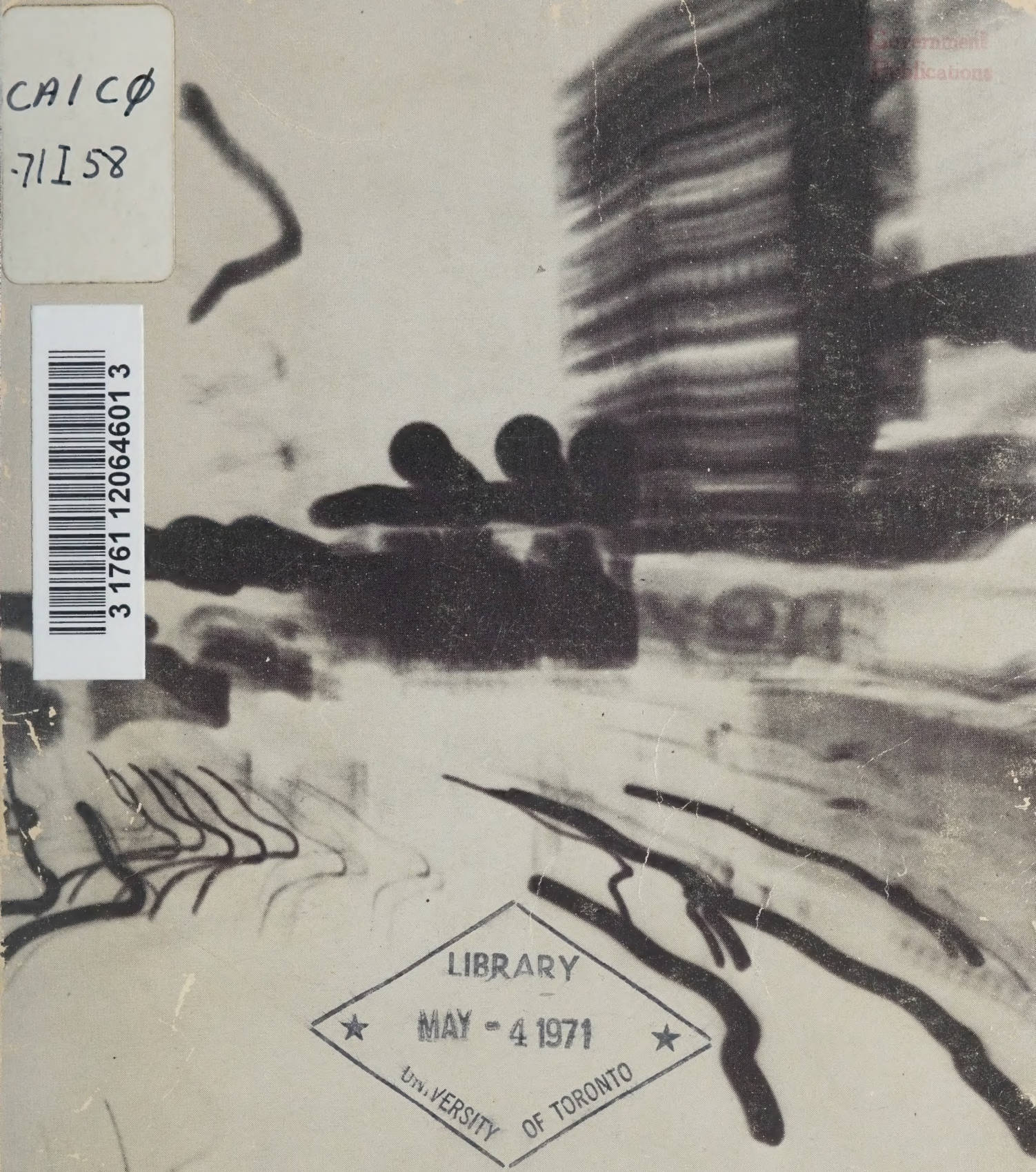


INSTANT WORLD

a report on telecommunications in canada

Canada

Communications Dept. Telecommission

General Publication

Instant world; a report on telecommunications in Canada

[G-17]

Available by mail from Information Canada, Ottawa,
and at the following Information Canada bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
Æterna-Vie Building, 1182 St. Catherine Street West

OTTAWA
171 Slater Street

TORONTO
221 Yonge Street

WINNIPEG
Mall Center Building, 499 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price: $3.00 Catalogue No. Co21-1/1971

Price subject to change without notice

Information Canada

Ottawa, 1971

INSTANT WORLD

a report
on telecommunications
in canada

TELECOMMISSION

THE HONOURABLE ERIC KIERANS

Minister of Communications

Sir, *I have the honour to submit a general Report on telecommunications in Canada, which has been prepared from the Telecommission studies undertaken on your instructions. It is hoped that this Report and the individual Telecommission study reports will be of assistance to the Government in considering the policies to be set forth in the White Paper on Communications Policy, which was announced in the Speech from the Throne on 8 October 1970.*

The reports of the individual Telecommission studies are now, for the most part, available for your examination. In accordance with your instructions, they are also being made available (except where the authors or sources of information have asked that access be restricted) through Information Canada to anyone who may wish to acquire copies.

The general Report sets out, as objectively as possible, various opinions and suggestions put forward by participants in the Telecommission studies, but contains no recommendations endorsed by departments or agencies of the Government of Canada.

A. E. Gotlieb,
Deputy Minister of Communications

PREFACE

On 18 September 1969, the Honourable Eric Kierans, Minister of Communications, announced plans for a comprehensive study, to be known as the Telecommission, of the present state and future prospects of telecommunications in Canada. The purpose was to gather as much information as possible, together with the widest cross-section of opinion, and the Minister accordingly said that participation by all concerned would be welcomed, and that briefs and submissions from any source would be given careful consideration. This general Report is intended to focus attention on the main issues and problems disclosed by the individual Telecommission studies, and presents options for consideration rather than recommended courses of action. It is hoped that it will be of interest not only to the Government of Canada, but also to the Governments of the Provinces, to municipalities, to the telecommunications industry, to various public and private institutions, and to the general public.

More than 40 separate studies were organized by a Directing Committee, comprising officials of the Department of Communications and the Privy Council Office, and the Chairman of the Canadian Radio-Television Commission. This report is the responsibility of the Directing Committee. Progress was monitored and coordinated by a General Committee consisting of representatives of the federal departments and agencies most directly concerned. The membership of the General Committee and the titles of the individual studies are listed in Appendices.

The studies were dealt with in several different ways. Some were prepared under contract by outside consultants, and a few took the form of submissions from representatives of the telecommunications industry. In most cases, however, the work was undertaken by a project team of officials, industry representatives, and users. Six conferences or seminars dealing with environmental and social aspects of telecommunications have been held in collaboration with universities, and the Department of Communications has been associated, in the course of the Telecommission studies, with two conferences dealing respectively with international problems and communications in the far north.

A written approach was made to each of the Governments of the Provinces inviting the free expression of opinion, and offering the widest possible consultation and cooperation in the development of future telecommunications policy. Senior officers of the federal Department of Communications have visited every Province for discussions with government officials and representatives of the telecommunications industry. In addition, the views of the provincial regulatory bodies have been sought in connection with particular studies that relate directly to their functions and responsibilities.

The reports of the individual Telecommission studies will all be published, except in those cases where access is restricted at the specific wish of

the authors or sources of information. As will be seen, the facts about telecommunications in Canada are far from plain and can be variously interpreted by those looking at them from different viewpoints. Moreover, there is no unanimity of opinion about the courses of action that might be followed, and the recommendations of outside participants and contributors are sometimes contradictory or mutually incompatible. Neither this Report nor the individual study reports represent the views of the Government of Canada or its departments and agencies, and no commitment for future action should be inferred from their contents.

Part I of this Report sets out, first, the complex background of problems facing the makers of telecommunications policy, together with some of the objectives that might commend themselves to any community, whether it be a group of people, a municipality, a province, a region, or Canada itself. Second, an account is given, in simple language, of the technological terms that recur throughout the Report in the discussion of problems and policy options.

Part II is addressed to the social aspects of telecommunications, now and in the future, including not only the promise but the pitfalls. The right to communicate, the demand for access to telecommunications, and the opportunities for participation in prospective benefits are discussed and balanced against some of the dangers that are foreseen, such as the invasion of privacy and the threat to intellectual property.

In Part III, a brief history of the development of telecommunications in Canada leads up to an account of the scene as it is today. This includes descriptions of the corporate structures of the industries involved, of the domestic and international services available, and of Canadian participation in international arrangements for the orderly use and development of facilities for global intercommunication.

Part IV is concerned with the future. The need for innovation that will improve services or reduce costs is related to the promotion of research and development, not only in technology but also in the social sciences relevant to the development of telecommunications in Canada. This is followed by a 20-year forecast of technological developments, an examination of the uses and management of the radio-frequency spectrum, and a discussion of the contribution that telecommunications may make to regional and northern development. The concept of a Canadian network of computer/communications systems is examined in relation to the problems of interconnection, together with the possible effects on predicted rates of growth for the industries concerned.

Part V deals with the responsibility of governments in the identification and protection of the public interest, with particular attention to the regulation of rates for telecommunications services. A brief description of the constitutional separation of legislative power between the Governments of Can-

ada and of the Provinces is followed by an account of the existing regulatory structure, its merits and defects, and some possible means of improvement.

Finally, a short concluding section summarizes the main issues that have been identified in the Telecommission studies and some of the various suggestions that have been made for their solution. The latter are not in the form of recommendations, but are presented rather as policy options for consideration by governments, industry, and the general public.

It is hoped that this general Report, taken in conjunction with the individual Telecommission study reports, will provide an informative background and stimulus for public discussion of the complex issues involved.

Telecommission Directing Committee

Chairman Allan Gotlieb
Deputy Minister of Communications

Pierre Juneau,
Chairman, Canadian Radio-Television Commission.

Gilles Bergeron,[1]
Assistant Deputy Minister (Operations), Department of Communications.

Henry Hindley,
Department of Communications; Executive Director, Telecommission.

de Montigny Marchand,
Department of Communications; Research Director, Telecommission.

Paul Tellier,[2]
Assistant Secretary to the Cabinet, Privy Council Office.

---

[1] Mr. Bergeron was assigned from 1 January 1971, before the drafting of this Report had been completed, to the federal Government's Bicultural Development Program.
[2] Mr. Tellier left the Public Service in July 1970.

TABLE OF CONTENTS

PART I

The Problem and the Means

The existing structure of Canadian telecommuncations systems is one of the most sophisticated in the world, but this is not to say that everything is perfect. Telecommunications policy may have to be re-shaped if full advantage is to be taken of the opportunities that technology affords and if socially undesirable effects are to be avoided. For, in the words of Francis Bacon, "he that will not apply new remedies must expect new evils; for time is the greatest innovator."

CHAPTER 1

A Message About the Medium

> "Telecommunication means any transmission, emission or reception of signs, signals, writing, images or sounds or intelligence of any nature by wire, radio, visual or other electromagnetic system."[1]

The first telecommunication service to be offered to the public, 125 years ago, was the telegraph, which was followed by the telephone, radiocommunication, broadcasting, and—most recently—remote access to electronically stored information and to data-processing services. Today, foreseeable developments in the technology of telecommunications and computers hold possibilities of a more convenient and satisfying way of life, the satisfaction being measured in spiritual as well as material terms. New and emerging techniques will offer access to information on a scale hitherto unimaginable, together with opportunities for a much wider participation in community affairs and the democratic process. For this reason, the social impact of telecommunications has been a prime object of attention in the Telecommission studies and in this Report.

Freedom of knowledge and freedom of speech are among the most valued privileges of a democratic society. The rights to hear and be heard, to inform and to be informed, together may be regarded as the essential components of a 'right to communicate'. These socio-political rights are not explicitly protected by legislation in Canada today, although some liberties closely associated with them are guaranteed under federal and provincial Bills of Rights. But the realization of a 'right to communicate' is a desirable objective for a democratic society, so that each individual may know he is entitled to be informed and to be heard, regardless of where he may live or work or travel in his own country. The people of Canada—as a body and as individuals—are therefore entitled to demand access to efficient telecommunications services on a non-discriminatory basis and at a reasonable price.

The geography of Canada, stretching 5,000 miles from coast to coast and some 3,000 miles from the United States towards the North Pole, of itself lends a unique importance to the need for efficient telecommunications. The metropolitan centres of an increasingly urbanized population are separated by great distances, while vast areas of the country remain undeveloped. New forms of telecommunications are having a diminishing effect on space and time which can be exploited to counteract these geographical disadvantages. The impending possibility of virtually instantaneous transfer of information in any form between all parts of the country not only helps to

[1] Radio Act, RSC 1952, c.233 (as amended), s.2(1) (i).

dispose of absolute distance as an obstacle to national trade and commerce but provides new prospects for reducing regional disparities and developing the Canadian North.

New and improved facilities for individual and group participation in national and community affairs will help to promote mutual understanding and interest between Canadians in widely differing social, cultural and regional circumstances. Moreover, there will be increased opportunities for English-speaking and French-speaking Canadians to express themselves and communicate with others across great distances in the language of their choice, for the expanding services resulting from new technology will greatly facilitate the use of either French or English in personal affairs, at work, and in individual contacts with governments and business institutions.

It seems probable that nobody, however deeply committed to the benefits of private enterprise, would deny that the implementation of telecommunications policy requires at least some governmental supervision and, for certain purposes, direct involvement. It should be clearly understood, in this context, that 'government' means the effective authority; in Canada, the effective authority may lie, in any particular matter, within the jurisdiction of Parliament, or of the provinces, or of both conjointly[2]. Thus, while there is clearly a national dimension in telecommunications policy, differences in regional, provincial, and municipal needs and attitudes can also be taken into account.

Governments are naturally concerned with telecommunications as an instrument essential to national defence, to the provision of safety services, and to the handling of emergencies. Further, if the 'right to communicate' is to mean anything in a country where many essential telecommunications services are provided by private enterprise enjoying protection from competition, governments will be concerned to see that those services are responsive to public demand over as wide a range as possible, and equally responsive to social and technological change.

The emerging technology of telecommunications offers the possibility of an eventual network affording universal access to the means of transmitting and receiving information in virtually any conceivable form. Although this concept is already technically feasible, the practicability and rate of its implementation are limited to a large extent by existing telecommunications plant and facilities which were designed for more limited services. The development of new facilities must also be related to the amount of capital and other resources that can be made available in Canada. There is an obvious danger that, in the transitional period, the nature and pace of development may be dictated by the most powerful private interests. An objective of telecommunications policy may therefore be to ensure that access to services and innovation in response to public needs are not unreasonably retarded by the weight of investment in existing facilities.

Telecommunications are heavy users of valuable resources, in the form of the electromagnetic spectrum, capital investment, research and development

[2] For a highly condensed discussion of federal and provincial jurisdiction over telecommunications see Chapter 18.

capacity, and professional manpower. The spectrum has practical limits, and its use must therefore be managed, subject to international agreements, to the best public advantage; a subject of growing concern is the prevention or control of radio-frequency 'pollution' (or 'noise') and interference. The telecommunications industry is capital-intensive, and it is in the public interest to ensure that the level of investment and the consequent availability of facilities are properly related to present and future requirements.

Canada has long been a beneficiary of foreign research and development in telecommunications, but has special problems which demand domestic innovative capacity; these include, perhaps most importantly, the social and environmental aspects of new services and facilities that will become available through technological development. Fears have been expressed about possible anti-social effects of new technologies which, it has been suggested, are not of themselves malignant but to be benign must first be tamed.

Concern for high quality of service calls for the development and promulgation of standards of performance and compatibility of equipment. Safety standards are necessary too, for telecommunications devices and equipment may be physically hazardous. Even aesthetic standards may be desirable as a safeguard against the erection of unsightly plant and equipment. In practice, standards that are mandatory for undertakings under one jurisdiction may be only exemplary for those under another; but if, as in Canada, undertakings subject to separate jurisdictions are parts of an integrated network of telecommunications systems, efforts to arrive at a standardization of standards in different parts of the country are obviously desirable.

There are certain aspects of telecommunications which afford grounds for public concern with the nature, volume, and availability of information transmitted or stored. The most obvious example, broadcasting policy, is outside the terms of reference of this report; nonetheless, the means to implement broadcasting policy are part of the technology of telecommunications, and may be improved by new systems and devices. Cable systems, for example, may one day become the predominant broadcasting channels in urban communities, but satellite transmission and new terrestrial modes will also contribute to the effectiveness of national broadcasting policy, and thus to the health of the body politic. Another example of public concern with the content of telecommunications, which may be of direct interest to all governments, is the availability and nature of information stored in public and private databanks to which telecommunications afford remote access. Telecommunications techniques increasingly afford opportunity for invasion of privacy, and for the misuse or distortion of information, from which the public may be entitled to protection.

The provision of public telecommunications services by private enterprise engenders economic forces which tend towards the establishment of monopoly situations in particular markets. The individual subscriber is likely to be attracted to the service that offers access to the largest universe of other subscribers, and the larger the total number of subscribers the greater

the economies of scale that develop. The process is cumulative and would, if unchecked, result in a total monopoly. When economic or regulatory checks are encountered, the tendency is towards agreements that provide for interconnection and withdrawal from competition in particular markets, which then become local or functional monopolies. Where it is clearly in the public interest that a particular kind of service should be provided by a single organism, either the service can be provided by the government, or private undertakings can be subjected to regulation in the public interest.

If governments engage, directly or indirectly, in the management of telecommunications services, the purpose may be either to establish an absolute monopoly (as in most countries other than Canada and the United States) in the public interest, or to provide essential services that are not economically attractive to private enterprise, or to establish an element of competition in an industry which, by its nature, tends to develop in monopolistic forms. The management of operations may be undertaken either directly, by a department of government, or indirectly through some relatively autonomous agency or corporation. In Canada, an operational arm or agency of one government may either be subject to the jurisdiction of a regulatory body established by the same or some other government, or may be self-regulating.

The compelling need for regulation of public telecommunications services arises from the requirement, which is accepted in one form or another by all governments in Canada, that the price of service should be just and reasonable, and that all public services should be offered on a non-discriminatory basis. These brave words, embedded in many a Canadian statute, land the regulatory authorities in the middle of one of the most controversial fields of economic theory, which is examined—in a Canadian context—in Chapter 17. It is necessary, however, to sketch in here some of the fundamental aspects of the problem.

The first important point is that the justness and reasonableness of rates are hard to establish without some knowledge of the true cost of each of the services provided; this is in itself a formidable task. The second is that rates should be just and reasonable not only for the customer but also for the telecommunications carriers, who are entitled to a fair return on their investment, to an extent that will enable them to attract the additional capital necessary for extensions and improvement of service and for necessary innovation.

The complexity of effective rate-regulation is enhanced by the fact that the telephone and telegraph companies, enjoying a monopoly status in the provision of some public services, are moving increasingly into the development of other services in competition with each other, or even with undertakings that are not primarily telecommunications carriers. Thus the opportunity is provided, unless constraints are applied, to subsidize the users of these other services at the expense of the general public. A further difficulty may arise when a carrier is also engaged, directly or indirectly, in the manufacture of telecommunications equipment, the price of which may be unduly inflated

—again at the expense of the general public; corporate structure may therefore be significant if rate regulation in the public interest is to be effective.

Where it appears that monopoly conditions or an exclusive franchise are necessary in the public interest, it would seem to be desirable to arrive at a clear definition of the services to which the monopoly conditions or franchise should apply. The problem, difficult enough in terms of a single carrier and a single regulatory authority, becomes even more formidable in Canada, with 11 independent jurisdictions; for a carrier may be in the position of offering a service, which is regulated under one jurisdiction, in competition with a similar service provided by another carrier, which is either unregulated or regulated on a different basis under another jurisdiction.

The achievement of some objectives of telecommunications policy may be promoted by the use of various financial and other incentives and disincentives. Taxation, for instance, may be discriminatory, one way or the other. Customs and excise duties, or subsidies, may be used to protect or stimulate a domestic industry, and in many countries public ownership of telecommunications facilities is used to establish a non-tariff barrier against the importation of foreign equipment. Subsidies may also be considered in circumstances where it is desirable, in the public interest, to extend the range of services and facilities beyond the point at which the cost should reasonably be carried by the beneficiaries or by other subscribers to the system. Incentives and disincentives, financial or otherwise, can also be built into the criteria established for economic and technical regulation. When, for example, a highly profitable franchise is to be licensed, a proportionate fee may be charged, or the licensee may be required to offer services of a nature or in a geographical area that would not otherwise be economically attractive.

The Telecommission studies have ranged far beyond the communications industries listed in the standard industrial classification published by the Dominion Bureau of Statistics[3]. One reason is the converging trend of the technologies of communications and computers, which is making it increasingly difficult to distinguish between the interactive services of data processing and transmission. Another reason is to be found in the close corporate ties between some telecommunications carriers and companies manufacturing telecommunications equipment. To complete the triangle, the provision of data-processing services in Canada, which are increasingly dependent on telecommunications facilities, is dominated by foreign manufacturers of computers and computer equipment. Although this *mélange* of separately classified industries may upset some purists in economic analysis, it can perhaps be justified on the ground that established classifications have been overtaken by the march of events.

One predominant theme emerges from the telecommission studies. The technologies of telecommunications and computers, effectively used in combination, could make a striking contribution to economic prosperity and the general quality of life in Canada; to the development of remote and sparsely populated regions of the country; to the extension of French and English

[3] DBS publication number 12-501, 1960.

broadcasting services from coast to coast; to the ability of individuals and groups in Canada to express themselves and communicate their views in the language of their choice; and to Canadian acceptance of responsibility for participation in the achievement of international objectives, especially the social and economic development of less fortunate countries in many parts of the world.

CHAPTER 2

A Layman's Guide to Telecommunications Technology

It is sometimes said that scientists and technologists talk in riddles; it is even occasionally suggested that they do so to develop and maintain the esoteric nature of their calling. Consequently, one of the difficulties in writing about complex technological matters for the lay reader is that compromise is unavoidable, and compromise is always a sitting duck for partisan critics. But some understanding of the technology is a *sine qua non* in any approach to the contemporary problems of telecommunications and their effects on people; the lay reader is therefore entreated not to skip this outline, in which technical terms are explained as simply as possible[1]. The experts, for their part, who might justifiably charge the writer with over-simplification, are enjoined, like the Corinthians, to suffer fools gladly, seeing that they themselves are wise.

All telecommunications systems have three principal components—terminal devices, local distribution, and long-haul transmission. The terminal devices most commonly in use today are telephones, teleprinters, and broadcast receiving sets. An important distinction arises between systems in which direct connections are made by complex switching apparatus (e.g. the telephone network), broadcasting systems, and point-to-point radio-communication, each of which has its own economic and technical characteristics.

In the telephone network, and in other automated systems operating on the same principles, the connection between one terminal and another is effected by the caller, whose signal activates the switching and control apparatus that selects, connects, and supervises calling pathways, and also provides for the recording of circuit-usage as a base for calculating charges. The connection may be confined to local distribution facilities, or may make use of inter-city transmission paths known as 'toll' circuits. Each terminal device has its own direct connection to the local exchange, but the quantity of switching apparatus and the number of toll circuits is calculated on the probability that only a small proportion of the terminal devices will be in use at the same time. Economy of operation is a function of correct balance between the number of terminals served and the predictable usage of switching apparatus and toll circuits.

[1] Definitions of technical terms contained in the text are identified in the Index.

In broadcasting systems, by contrast, the signals of a central transmitter can be received by an unlimited number of terminals within its effective range, which can now be extended for television and FM radio by the use of a community antenna and distribution by cable (CATV). No switching apparatus is required, and the economics of operation call for the largest possible number of receiving sets to be in use at any time.

Direct point-to-point radiocommunication (e.g. air-traffic control) between pairs or networks of terminals is effected by calling identification in plain language or by selective calling devices, and each conversation occupies a radio frequency that might otherwise serve many people if used for broadcasting. The use of too many terminals simultaneously may result in congestion and, whereas the capacity of a switched network can always be increased by adding circuits and switching apparatus, the number of radio frequencies that can be made available for point-to-point communication is limited by the nature of the radio-frequency spectrum[2].

Telephones and teleprinters are normally connected by a pair of copper wires to the local switching office, and thence to the toll office or exchange by multi-paired cables. In a multi-paired cable carrying many transmissions along a common route, the signals from one pair may intrude on other pairs, an effect (known as 'crosstalk') which becomes worse at higher frequencies and limits the utility of paired cable in distribution systems. However, a device called a coaxial pair consists of an insulated centre conductor surrounded by a copper tube effectively shielding it from interference; by reducing losses, the range of usable frequencies is greatly increased. Each coaxial pair is capable of carrying up to 1,800 two-way voice circuits; coaxial cables containing numerous coaxial pairs within an outer sheath and carrying up to 32,400 two-way conversations are in regular use. In the United States, Bell Telephone Laboratories are about to start testing a new 22-tube coaxial cable system which, it is expected, will eventually be able to carry up to 90,000 two-way conversations.

The effective capacity of a telecommunications link is known as its usable bandwidth, and line-sharing can be achieved either by Frequency Division Multiplexing (FDM) or Time Division Multiplexing (TDM). In very simple terms, FDM divides the bandwidth up into usable slices separated by electrical filters—rather like a multi-decker sandwich—so that signals can be carried by each slice simultaneously. TDM, by contrast, uses the whole bandwidth in short sharp bursts—now you have it, now you don't—for successive signals; each burst of signals is sequenced so that it comes out in the right place at the other end, and the discontinuity is imperceptible. In the context of TDM, milliseconds are out and time is measured in microseconds; a microsecond is one-millionth of a second. In some computer

[2] See Chapter 12.

applications the units are picoseconds, and a picosecond is to a second as a second is to 31,689 years.

Telephone distribution facilities were originally designed for voice communication, which has a low bandwidth requirement; this constitutes a limiting factor on the number of services that can be simultaneously provided and the speed at which data can be transmitted. Both could be very greatly increased by total conversion to coaxial cable connections but this does not appear to be an immediately practical proposition.

CATV cables can at present distribute from 12 to 25 TV channels, depending on distance and repeater spacing, and 40 to 50 channels are envisaged for the future. Although most home-receivers in Canada today can receive only 12 channels, converter equipment would provide increased capacity[3]; in January 1971, the Minister of Communications announced that, subject to licensing requirements of the Canadian Radio-Television Commission, CATV systems will be permitted to make use of a larger number of channels, up to 20 or more, in the near future. The terminal equipment at both ends of the CATV cable, and the repeater amplifiers, are in most cases suitable only for one-way traffic; no complex central switching is necessary, as in telephone distribution facilities, for the customer can select the channel he wants by turning a knob on his receiver. Coaxial-cable systems used for CATV distribution could be adapted to carry limited two-way traffic by the incorporation of appropriate terminals and amplifiers; full two-way point-to-point service would require complex switching facilities.

The home demand for two-way communications services of this kind will almost certainly be limited, for some years to come, by the relatively high cost to the customer, and perhaps for even longer by other factors, including customer-resistance. However, the rapidly increasing demand for data transmission and communications with and between computers is likely to accelerate the installation of dedicated or shared broadband[4] cable connections, not only in business and industry but also in the educational system. By using available techniques, many data channels could be carried on a single coaxial cable without mutual interference; the necessary data-processing and switching equipment is at present expensive, but costs are likely to be substantially reduced by the introduction of new techniques.

For new kinds of service becoming available in the home, the likelihood is that existing two-way systems, with all their limitations, will be

[3] Television sets now being manufactured and sold in Canada are required, by a regulation under the Radio Act, to have a capacity for direct reception of UHF broadcasts, but this does not necessarily increase their capacity for reception of cable transmissions.

[4] 'Broadband' is a relative or qualitative term used, rather loosely, as a general indication of bandwidth as relatively broad rather than narrow; a single voice-channel, for example, would be regarded as narrow-band, and a coaxial-cable or microwave system as broadband.

used for some purposes, and existing one-way systems for others, or new hybrid systems may be developed. For example, given sufficient channels, on-demand entertainment service could be made available on CATV cables, the selection by the customer being effected either by making a telephone call to the system operator, who would make the necessary connection to transmit a 'canned' program, or by the customer punching out the appropriate code on his Touch-tone instrument.

The concept of 'canned' programming, easily recognizable in the form of phonograph records or home movies, can now be applied to all kinds of audio-video programming for playback through a standard television set. Several different methods of 'canning' are now available or in an advanced stage of development. Electronic Video Recording (EVR), developed by the Columbia Broadcasting System, uses miniaturized film coiled in cartridges which can be inserted in a converter unit connected to the antenna terminals of a television set; the sealed cartridge, which threads and rewinds itself, can carry 25 minutes of colour programming, up to 60 minutes of black-and-white programming, or—if books are filmed at a page per frame—about 500 average-length novels. Several competitive devices, often designated as videotape-recording (VTR), are being developed. The Sony Videocassette plays back magnetic videotape in colour through a standard television set and has two audio tracks, either or both of which may be selected during playback, to accommodate stereophonic or dual-language programs. The cassette, which contains up to 110 minutes of programming, can be erased and used for new recording, and program material may be recorded on the cassette either by the supplier or, through a special recording adapter attached to the television set, by the user. Thus, for example, on-air programming can be temporarily (or permanently) recorded for delayed replay, or a form of home-movie could be made by using a low-cost portable TV camera. Devices using similar or comparable techniques are also under development by RCA and other manufacturers.

A technology which is fundamental in computer science may, as a result of cost reductions, have a profound effect on the introduction of new telecommunications services. At present, telephone circuits and CATV cables, using Frequency Division Multiplexing (FDM), transmit signals in analog form—that is to say that there is a continuous flow of signals in a form analogous to what goes in at one end and comes out at the other. In analog tranmission systems, care has to be taken to avoid interference when different types of signals are multiplexed, and noise and distortion are cumulative from repeater to repeater. In other systems, signals are transmitted in what is known as digital form by the use of binary numbers; the difference between ordinary numbers and binary numbers is that the former are expressed by combinations of ten symbols, while the latter employ only two. Signals in

digital form must therefore be broken down to components that can be expressed in one way or the orther—'yes' or 'no', 'present' or 'absent', 'on' or 'off'. Answers such as 'perhaps' or 'go slow' can be derived only from a particular balance of positive or negative components. Analog signals (telephony, for example) can be transformed into digital signals by a series of operations known as Pulse Code Modulation (PCM). This permits the interleaving of several thousands of signals, which are decoded into the original analog form at the other end (that is to say at the point to which they are directed).

The advantages of this digital form of signal distribution are that distortion is virtually eliminated and, although repeaters are required, noise and distortion are not cumulative as they are in other forms of transmission. By use of regenerative repeaters, digital signals can be transmitted over very great distances with negligible degradation. The proliferation of digital computers has resulted in a rapidly growing demand for many types of digital terminals.

To elucidate computer technology briefly in lay language would be a formidable undertaking which, fortunately, is not necessary in this context. It is sufficient to say that computers can be designed and programmed to accept instructions or data given to them audibly, visibly, mechanically, or electronically; to store the instructions or data indefinitely or temporarily; to implement, as required, instructions which may entail the processing, or conversion into some other form, of data contained in the instructions or stored in the computer itself or in some other computer, or a combination of any two or all three; to exercise a form of logic by using intermediate output as the basis of choice between alternative subsequent procedures in infinite succession; to cause, monitor, and control external electronic or mechanical actions, reactions, and procedures; and to produce legible, audible, or visual output in almost any required form.

The enormous flexibility and manageable size of computers being designed today has been made possible by new metallurgical and electronic manufacturing techniques, and circuit and device speeds have increased by several orders of magnitude since the introduction of the transistor into computer logic. Large numbers of electrical circuits can be built into a tiny wafer, known as a 'chip', capable of performing a complete specific function as part of a sub-system, such as the adder in a computer. Large-scale integration (LSI) techniques now being developed will permit a single chip to carry out a whole sub-system function independently from other parts of the system. By the mid-1970's computers may be working at speeds up to 1,000,000,000 operations a second.

Many purposes can be served by relatively low-cost free-standing mini-computers, the economic usefulness of which is likely to be enhanced

by the conjoint employment of compact video-recorders and playback systems (as described above) for data storage and retrieval. In general, however, the speed at which computers can implement instructions very greatly exceeds the speed at which instructions can be given or the answers accepted by the user, unless the computer is dealing with another computer. Thus, the capacity of a computer to deal with many transactions at the same time has led to the development of multi-programmed data-processing systems in which a large central computer is used to carry out the instructions of several users. In some systems, the work is done in batches, one job being completed before the next is started, but a technique known as 'time sharing' makes it possible for a single central computer to serve many users simultaneously. The computer switches from one user to another, or several others, and back again in a time cycle corresponding closely to typical human response time; ideally, any single user at a remote console is unaware of the intermittent nature of the service and has the impression that the system is at his sole command.

These developments have given rise to an increasing demand for telecommunications links between computers and remote users. In the past, this has been largely satisfied by the use of dedicated private lines, but there is a rapidly growing number of users who need computer time only on an intermittent basis, for whom a dedicated or even a shared private line might be uneconomical. This form of intermittent connection can be provided by the switched telephone network; with suitable terminal equipment, connections can be established, whenever and for as long as they may be required, as simply as in making a telephone call, even though the transmission facilities, which were designed for voice communication, are not the most efficient that could be devised for many data-transmission purposes.

There are many different types of business machines, as well as computers, which can usefully be connected to telecommunications facilities, but many of them require, for economical use, much higher speeds than can be accommodated on one voice channel. To meet these requirements, the telecommunications carriers have recently introduced broadband data-transmission systems offering various bandwidths and higher switching speeds. It is these developments, among others, that have made it necessary to conceive of telecommunications as a subject that cannot usefully be considered without regard to computers, databanks, and data-processing systems and services.

Many data-processing applications and services are feasible only through a combination of telecommunications and computer technology; in this regard, the total effect is greater than the sum of the parts. But the computer, quite apart from its usefulness when connected to telecommunications systems by appropriate terminal devices, has become an important feature

of another element of telecommunications technology—that of switching and storage equipment. Here a distinction must be drawn between line switching and message switching. Line switching entails control equipment, employing either wired or computer logic, which responds to dials or push-buttons activated by the user; in other words, when a call is made on the telephone, for example, it is the line-switching equipment which makes the precise circuit connections between the caller and the called. Message (or store-and-forward) switching provides for the complete text to be recorded and held until a suitable transmission channel becomes available; electro-mechanical equipment is now giving way to central computer-processors which have the ability to store, alter, retrieve, and forward information according to instructions.

In designing a telecommunications system for a particular purpose, a primary technical objective is the achievement of an optimum mix between different types of switching, transmission, distribution, and terminal equipment. But the optimum technical combination may be, and often is, distorted by cost factors, so that the overall optimum mix may differ from the optimum technical mix. When data are to be processed on a remote computer, for example, the balance between terminal and line costs is a key factor; transmission costs can be reduced by the use of sophisticated data terminals, but these are themselves very expensive, so that when transmission costs are not important, as in short hauls, simple low-cost terminal equipment will do everything that is required.

Attention can now be turned from wires, cables, switching, and terminal devices to radiocommunications. The radio frequency spectrum[5] is broken up, in conformity with international agreements, into bands dedicated for particular uses with minimal interference. The frequencies used for public radio and television broadcasting are, in contemporary terms, at the lower end of the scale, although their descriptions range from Medium Frequency (MF) through High Frequency (HF) and Very High Frequency (VHF) to Ultra High Frequency (UHF). Although several bands within this range are used for other special telecommunications purposes, such as connections with mobile units, in the future the chief interest for what might be termed public telecommunications lies in the very much higher frequency ranges.

HF radio systems are decreasingly used for public telecommunications other than broadcasting; although long distances can be covered, transmission is limited to a single voice-circuit, and signals are extremely vulnerable to interference. Better results can be achieved by scattering radio signals from the troposphere—the lower portion of the atmosphere. In tropospheric scatter (troposcatter) systems, high-power transmitters feed the signals to large antennas, with diameters up to 120 feet, for reflection from the tropo-

[5] See following chart.

sphere; transmission performance can be highly reliable, but troposcatter systems are expensive and have insufficient bandwidth for television transmission.

Microwave transmission uses bands in the upper regions of the frequency spectrum. One microwave radio frequency channel (or system) can initially transmit up to 1,800 voice circuits, or one television signal, but this capacity can be progressively augmented up to 12 times this amount (per system) by additional radio equipment. Signals are forwarded by line-of-sight repeater stations at intervals of about 30 miles.

Communications satellites offer the great advantage that distance is not a factor in transmission costs. The upcoming generation of satellites (Intelsat IV), the first of which was launched on 25 January 1971, will each have a capacity of 3,600 to 9,000 voice-circuits, depending on system configurations designed for particular transmission purposes. Signals from the satellite are received by special earth-stations, from which they are distributed by terrestrial communications systems. Satellite systems are already competitive with long-haul international cable networks and offer an alternative to domestic microwave and long-line transmission systems; they are particularly useful in the development of telecommunications for remote areas, such as the Canadian North, which cannot be easily reached by terrestrial systems. Earth stations serving relatively small communities are already technically feasible, and direct home-reception of broadcasting from satellites may be possible in the 1980's, if exclusive radio-frequency channels can be provided and costs sufficiently reduced.

The foregoing brief outline is intended only to acquaint lay readers with the principal features of telecommunications technology in use today or being tested under working conditions. A forecast of technological developments in the next 10 to 20 years will be found in Chapter 11, but need not be cause for alarm or despondency. Throughout history, new technology has often been the object of superstition and fear until it has been put to use and its benefits recognized. Given understanding, there is no good reason to fear the technology of telecommunications.

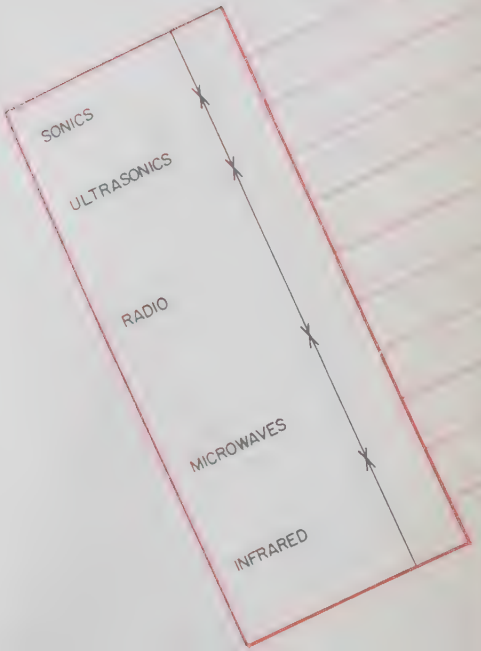
> *"L'homme y passe à travers des forêts de symboles*
> *Qui l'observent avec des regards familiers."*[6]

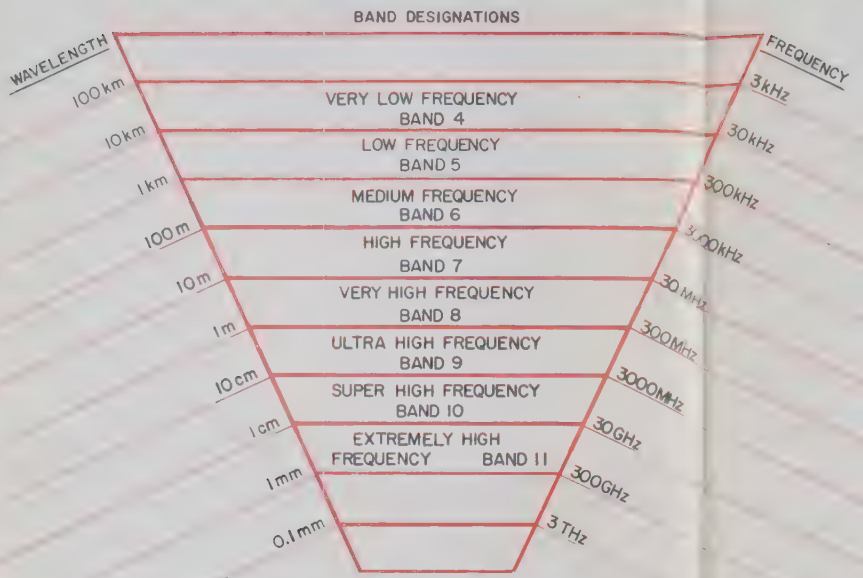
It is up to man himself to make the symbols familiar.

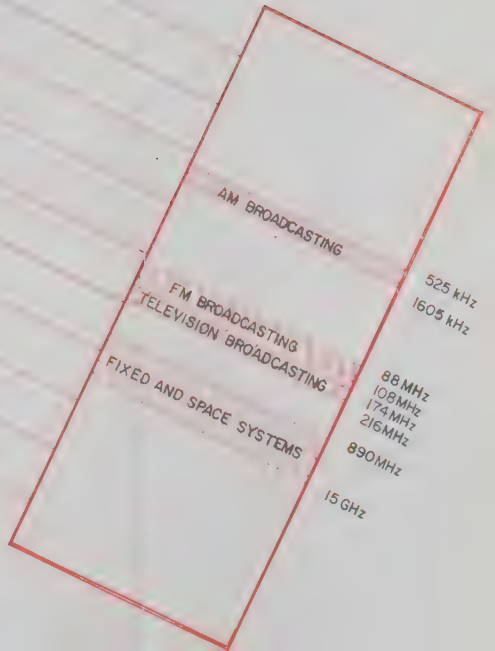
---

[6] Charles Baudelaire, *Correspondances.*

ELECTROMAGNETIC SPECTRUM







PART II

Telecommunications and People

During the course of the Telecommission studies, the Department of Communications organized and sponsored several seminars or conferences to examine some aspects of the impact that the new technology of telecommunications may have on individuals and on society as a whole. The substance of the next two chapters has been drawn largely from those discussions and the background papers that were presented. The relevant Telecommission study reports[1] are:

6(a) 'Telecommunications and Participation', a Seminar held at and co-sponsored by the University of Montreal.

6(b) 'Access to Information', a Seminar held at Carleton University, which was co-sponsored by the Department of Regional Economic Expansion.

6(c) 'Telecommunications and the Arts', a Seminar held at York University, which was co-sponsored jointly by the University, the Canada Council, and the Department of the Secretary of State.

6(d) 'The Wired City', a Seminar held at the University of Ottawa, which was co-sponsored jointly by the Central Mortgage and Housing Corporation and the federal Department of Transport.

5(b) 'Computers: Privacy and the Freedom of Information', a Conference held at Queen's University, which was co-sponsored jointly by the University, the Information Processing Society of Canada, and the federal Department of Justice.

---

[1] *An informal preliminary conference, for which no report has been prepared, was held at Loyola College, to discuss possible approaches to the Telecommunications Environment studies.*

CHAPTER 3

Soul in the System

"Technology can give society just about anything it wants: but what does society want?" This question came up in one form or another, but without generating a straight answer, at all the Telecommission seminars on telecommunications and the social environment; it may well be unanswerable, but must nonetheless be faced. The technological ability to give society almost any conceivable material product has been described by U Thant as "the central stupendous fact of our times." But technology is also producing a great many things that society plainly does not want—polluted air, contaminated water, overcrowded cities, a decaying countryside, and the threat of a machine-dominated environment which may shrivel human identity. How should society exploit the promise of technology while safeguarding againsts its evident dangers?

In the context of telecommunications, who is to decide what society wants? How is the collective will of society to be measured? What happens when society changes its mind? These issues are removed from, but by no means irrelevant to, such mundane problems as telephone rates, regulatory procedures, switching technology and markets for Canadian products, with which many of the other Telecommission studies were concerned. But, unless technology is to be regarded as no more than plumbing, it is not sufficient to ask only 'how?' and 'how much?'. The reason for holding the Telecommunications Environment seminars was to ask 'why?' and 'what for?'.

Each of these meetings lasted three days, and the issues were examined from different, but in no way exclusive, points of view. All told, the discussions brought together about 400 experts, each familiar with one or another aspect of communications but, much in the manner of Bertrand de Jouvenel's *forum prévisionnel,* drawn from a wide variety of backgrounds. The disciplines represented included computer science, engineering, business and industry, law, sociology, anthropology, education, psychology, economics, architecture and town planning, social work, medicine, the visual, literary, and performing arts, broadcasting, film-making, and public administration. Each seminar was made up of a series of panel discussions; the panellists' arguments and position-papers were then threshed over in detail by small

interdisciplinary workshops. At the close, all the participants met in plenary session to arrive at, or to fail to arrive at, broadly accepted conclusions.

The seminars were an unusual way of trying to cope with an unusual subject; they were untidy, emotional, irreverent, at times serendipitous, and at other times irrelevant. In part, the untidiness resulted from the format, but even more from the subject. As a topic, 'Technology and Society' is only slightly narrower in scope than 'God, Man and the Universe': well informed experts can find room enough within it to argue persuasively from totally contradictory positions. It is, for example, rationally arguable that technology is only plumbing, and that man's essential nature and behaviour will never change, no matter how many machines may clutter the landscape—or, indeed:

> "While you and i have lips and voices which
> are for kissing and to sing with
> who cares if some one-eyed son of a bitch
> invents an instrument to measure Spring with?"[1]

It is equally reasonable to adopt the pessimistic philosophy of technological determinism, and to believe that in creating machines with which to conquer nature, man, himself a part of nature, has created diabolical monsters that will surpass him; that man, in other words, must inevitably become a servant of his machines, a tool of his tools.

To confuse matters still further, the social effects of technology are often ambivalent. A road may bring new life to an isolated community or, as easily and as unpredictably, drain life away. The same can be said of telecommunications systems. Public databanks, for example, by making limitless amounts of information available to everyone, can bring about massive political and social decentralization; conversely, by making limitless amounts of information available to the authorities, they can bring about centralization of power on a scale never before possible—for even the writ of a royal tyrant could travel only as far and as fast as his horses could run.

Many participants, for all their concern about man's uneasy partnership with contemporary technology, were even more worried about the prospects for this partnership in the future when machines have become still more powerful and pervasive. In recent years a new academic discipline has developed—sceptics might call it a fad—which has come to be known as 'futurism'. Its adherents are convinced that, as Dennis Gabor, a British engineer, has said, ours is the first generation "to experience its own future", and that we are less and less the product of our past and more and more the product of what is yet to come. Searching for a way to describe this new condition, Alvin Toffler has arrived at 'future shock'; Peter Drucker speaks of 'discontinuity'. There is no way back, even if some are no happier to go

[1] e.e. cummings, *Collected Poems* (Harcourt, Brace & World, Inc., 1959).

forward into the technological *Brave New World*. That world of Aldous Huxley's has been given many new names: Ellul's 'technological society', McLuhan's 'electronic age', Calder's 'technopolis', Brzezinski's 'technotronic society', Mumford's 'mega-machine', and the most overworked of all, Daniel Bell's 'post-industrial society'. In the end all the names amount to the same thing—a society built upon and shaped by technology. Man has been variously described as a social animal, a religious animal, a political animal, and an economic animal; he is becoming—so the futurists say—a technological animal, who will live in a society as different from that of today as the latter is from pre-industrial societies. At the Arts Seminar, the artist Michael Goldberg lamented:

> "Time was when every artist could be his own Thoreau. But the woods aren't there any more."

Technology has fundamentally transformed the human condition at least twice before. The development of agriculture destroyed the foundation of nomadic societies; with an assured supply of food, man could congregate and organize a permanent social order. The industrial revolution transformed a grouping of primarily agricultural communities into the mass urban societies of today. How the third technological revolution will shape our ends is still far from clear, but its nature and substance are already becoming familiar. The industrial revolution was concerned with the production and distribution of goods; its technology was that of the steam engine, the spinning-jenny, and the blast-furnace. The post-industrial revolution is concerned with the production and distribution of information; its technology is that of computers and communications. The industrial revolution supplemented and often replaced muscle-power; the computer/communications revolution supplements and extends brainpower and the information on which it feeds. In searching for answers to the questions 'why?' and 'what for?' in the context of an impending computer/communications revolution, if that prediction is accepted, it is necessary to take into account the exponential curve of technological advance and its socially ambivalent effects.

It has been said many times that 90 per cent of the scientists who ever lived are alive and working today, but the same could probably have been said in 1871, or indeed in 1771 or 1661. What is really significant is that every scientific discovery is in itself a launching pad for others, so that the curve of technological advance, which diverged almost imperceptibly from the horizontal for several millennia, has not only gone round the bend but is now converging on the vertical. At some unidentifiable moment in this century, the volume of accumulated knowledge upon which new inventions and discoveries are based seems to have reached a critical mass, a point of

no return, beyond which the ambivalent social effects of self-generating technology may have become uncontrollable.

Whether or not technological progress is now out of social and political control, as philosophers like Jacques Ellul believe (Ellul has argued further that control can never be regained), technological change is now so rapid that individuals and social institutions no longer seem able to adapt to it. By demolishing the familiar, accelerating technological change is bringing about serious social and psychic disturbances. Benjamin Singer, of the University of Western Ontario, described their pathology:

> "Bombarded by ever-increasing rates of message transmission, man becomes fragmented and disoriented. Nothing seems real or permanent —everything is transient in a world where more than 90 per cent of the knowledge that will be available in one's lifetime will be generated during it. Images, character, styles, even his own identity are part of this sense of transience, breeding even more insecurity."

A large part of contemporary dissent appears to flow directly from this sense of transience and insecurity. The ideology of progress, unbroken in the West since the Renaissance, is today being challenged by large numbers of people, mostly young, who are searching for woods that no longer exist, and who maintain disapprovingly that the mechanical destroys the organic—what is made destroys what grows. In fact, the extremes of psychic and social dislocation so evident today may have come about because two revolutions are going on at the same time—the electronic post-industrial revolution, and the counter-revolution of consciousness, as Charles Reich has called it in *The Greening of America*[2].

The tendency of technology to produce undesirable social effects that counterbalance some of its benefits is self-evident and technophobia is scarcely new. Blake feared "those dark Satanic mills" of the industrial revolution, and the Victorians divided into 'technologist' and 'humanist' camps. Their debate, which in essence pitted the pastoral cottage-industry philosophy of William Morris against the engineering wizardry of Brunel, has come down to us almost intact. The difference today is that, because technology has become so much more powerful, the debate between 'technologists' and 'humanists' is deeper and sharper. At the seminars, engineers and scientists were bombarded with such questions as: "what about the SST?"; "what about the space-race?"; and, closer to home, "what about the Spadina Expressway?" One distinguished computer-scientist was driven to retort "I'm sick and tired of being made to feel the villain for all the world's ills."

These words were revealing, for in this debate, depending upon the individual point of view, computers represent either the ultimate threat or the ultimate hope. Computer scientists or salesmen have, it is true, often

[2] Random House, Toronto, 1970.

promised a great deal more than they have been able to deliver. Computer art, for example, has yet to reach much beyond the level of technical virtuosity. In recent years, much of the heady speculation about artificial intellect and 'heuristic' learning by machines has died down; computers cannot yet play chess well enough to beat a Grand Master. At the Arts Seminar, the playwright Jacques Languirand explained why he personally believes that man will always be smarter than his machines:

> *«L'ordinateur lui-même ne sera jamais véritablement «créateur», même s'il procède analogiquement: son fonctionnement binaire (au sens à la fois philosophique aussi bien que technologique) en fait un passif, alors que l'homme procède du ternaire (au «oui ou non» de l'ordinateur s'oppose le «oui et non» de Pythagore.»*[3]

However, there is another school of thought, as there is at every step in the discussion of technology and society, for the creative capacity of computers must be related, inevitably, to a definition of creativity. Technically, the binary nature of computer operations is no more relevant to creativity than the fact that written English has only 26 characters against thousands commonly used in written Chinese. The truth is that the human brain is infinitely more complex and perceptive than any electronic machine that has yet been built, although many experts believe that, by the end of this century, computers will be able to match, simulate, or surpass the most identifiably human forms of intellect, as well as having some new kinds of ability beyond those that man can in himself command. The Institute for the Future predicts that, by the turn of the century, computers will have been built which not only comprehend standard IQ tests but score over 150. The relevance of such an achievement to creative ability is questionable, and some authorities, in the attempt to find a basis for the belief that man is perpetually unique, have come to the point of arguing not that computers are unlike men but that man is unlike the computer, and always will be.

Whatever the ultimate limits of computer capability, there may well be grounds for pessimism about its total impact on society. But fashionable pessimism can drift, self-indulgently if subconsciously, into escapism. To over-emphasize the dangers of technology is to discount, even to squander, its immense potential for social progress. Public databanks for example, could make almost limitless information available to everybody, if all the technical problems can be resolved, costs sufficiently reduced, and consumer-resistance overcome. Computers are already being used to good effect in education, medical diagnosis, urban planning, and industrial design. Without

[3] Editor's translation: "The computer itself will never be genuinely 'creative', even though it proceeds by analogy; its binary operation (in the philosophical as well as the technological meaning) renders it passive, while man proceeds from the ternary (the 'yes *or* no' of the computer against the 'yes *and* no' of Pythagoras)."

computers, man could not have gone to the moon, leaving aside the question of whether the trip was really necessary. Given the complexity of modern life, to which computers themselves have contributed, it is probable that society can no longer be effectively governed and administered without computers.

Some of the products of new telecommunications technology—multi-channel cable systems, home video-casettes—have within them at least the promise of transforming broadcasting, which is now a one-way medium that treats viewers as largely passive homogeneous groups, into an interactive medium; more and more people will then be able to decide for themselves what they want to watch and when they want to watch it and, still more importantly, to originate programs themselves. Thus, the electronic mass-media will perhaps be transformed into more individualized kinds of media.

Participants at the seminars, having first established the general background of discussion reflected here, looked for ways to fulfil the promise of technology and lessen the threat, and moved on to a more particular examination of telecommunications systems and the ways in which they might be used or developed to give society what it wants—or seems to want. The ultimate goal of communications engineers and designers is to build systems that re-create, at a distance, the effect of face-to-face communication —to build what Gordon Thompson, an engineer with Northern Electric, expressed as "a common communications space." Face-to-face conversation permits communication not only by voice and hearing but also by sight, gesture, smell, and touch. The videophone adds the visual to the audible dimension. 'Conference-vision', a project of the British Post Office, amounts to two-way closed-circuit television. The sensation of touch has been transmitted by electro-magnetic means, a step towards the 'feelies' of *Brave New World,* but the transmission of the other senses has so far eluded the talents of the systems engineers. Another engineering objective is to consummate the marriage of the once separate technologies of computers and communications. The outcome, ultimately, would be a multiple-access information-retrieval network, through which people at home or in the office can have access to all available information, and at the same time have the means at hand to manipulate and process that information in almost any way and for almost any purpose they may have in mind.

The Report of the Arts Seminar quotes a description by Nigel Calder, the British science journalist, of this ultimate computer/communications network:

> "Think of a system incorporating the computing, publishing, newspaper, broadcasting and library, telephone and postal services of the country, together with large slices of teaching, of operations and of many professional activities. All these each growing in its own right and

> subsumed in one system will outstrip in magnitude and importance any industry or collective activity in which human beings have been previously engaged."

Yet simply to say that this system will organize and make available just about every piece of information that is useful (and a good deal that is not) is to miss half the point. The system will organize the information inside it; it may also organize the society around it. Gyorgy Kepes, Director of the Center for Advanced Visual Studies at the Massachusetts Institute of Technology, who was the keynote speaker at the Arts Seminar, has put the point this way:

> "Concern with technology must be based upon a real understanding of what technology is today. Technology today does not simply imply a physical implement, a 'machine', mechanical or electronic, but a systematic, disciplined, or collaborative approach to a chosen objective. There is a new technology that Daniel Bell has called 'intellectual technology'—this is what artists must understand and accept."

Many of the artists and other participants in the seminars understood but refused to accept. In the early days of the industrial revolution, the Luddites attacked the machines that threatened their livelihood; today, the Luddites of the information-revolution oppose not so much the machines themselves as the mechanistic social environment which they fear that machines may create. One participant said that "we have made man fit into our communications technology rather than the other way around". The most biting criticism was made by Jacques Godbout of the National Film Board:

> «*Le vertige qui s'empare des gérants, en effet, tient à la quantité fabuleuse des connaissances dont ils voudraient assurer à la fois la concentration, la conservation et la dissémination rationelle afin qu'elles servent à perpétuer la dictature économico-technologique qui les fait vivre. Quand on présente à un technocrate de l'information un crystal holografié qui entre le pouce et l'index contient cent couches d'information visuelle, il se met à saliver comme une nymphomane dans un collège militaire.*»[4]

Godbout's sentiments were echoed at all the seminars. Alan Westin of Columbia University, the keynote speaker at the Seminar on Participation, said that information technology, "as an inevitable function of its complexity and cost, reinforces those who already hold power." Léon Dion, a political scientist at Laval University, said that it tends to favour régimes of the 'demago-technocratic type', but also revealed the ambivalent character

[4] Editor's translation: "The intoxication that takes hold of managers is in fact due to the fabulous quantity of knowledge which they would like to concentrate, conserve, and disseminate rationally so as to ensure that it will perpetuate the economic-technological dictatorship that provides them with a living. When an information-technocrat holds between thumb and index-finger a holographic crystal containing a hundred layers of visual information, his mouth waters like that of a nymphomaniac in a military college."

of information technology, and therefore the impossibility of arriving at simplistic conclusions, by positing the opposite argument—that technology might also open the way to what he called a new humanism. As he explained:

> «*Le phénomène de la contestation lui-même paraît imputable dans une large mesure aux télécommunications, pour autant en tous cas que ces dernières véhiculent et cristallisent la révolution des 'frustrations croissantes', prélude possible d'une révolution politique qui pourrait engendrer une civilisation nouvelle.*»[5]

Another political scientist, Dale Thomson of Johns Hopkins University, made a very similar diagnosis:

> "Communications systems make available new concepts, alternative ways of life. They erode established patterns and values. They create new demands without satisfying them, and lead to dissatisfaction."

Information technology therefore, is not only an object of dissent; it may also be the creator of that dissent, perhaps on a scale to compel a change in the social order. Many participants clearly assumed that communications and the effective exercise of political power are almost synonymous. Their view was that, in an age of total information, access to information and the ability to manipulate it are equivalent to having and exercising power. Politicians are well aware of this relationship. In totalitarian régimes, as one participant said, "the flow (of messages) will be largely outward from the centre of power; a more democratic government will have a larger inflow than outflow in terms of the quantity of messages."

On the other hand, the nature of computer/communications technology is so different from that of the older industrial technology that its impact on political and social processes may be quite different. Industrial technology is mechanical, sequential, structured, and has fostered the development of a structured hierarchal society. Electronic technology, as McLuhan has argued, is instantaneous, simultaneous, all-at-once; extremities receive messages almost as fast as the centre, and the exclusivity of information, always the foundation of authority, is dissipated and dispersed. Hence, even though computer/communications technology, like all technologies, requires a disciplined team of engineers and technocrats for its development and operation, its basic nature will inevitably promote an egalitarian society in which control over individuals who know too much, too quickly, becomes less and less feasible. Plainly, the full effect of these characteristics of electronic technology will not become evident for a long time. Plainly also,

[5] Editor's translation: "The phenomenon of conflict in itself seems to be largely imputable to telecommunications, at least to the extent that they transmit and crystallize the revolution of 'growing frustration', which is perhaps the prelude of a political revolution that might generate a new civilization."

these are only two among a multitude of interacting forces affecting the body politic. In a number of immediate and pragmatic ways, however, these attributes have not only been recognized but are already being used to achieve defined social and political goals.

As the seminar participants heard, film and videotape have become tools for community development in areas as far apart as Newfoundland and Alaska, giving a voice, and the self-confidence to use it, to people who until now have more often than not been voiceless in community affairs. In the Saguenay/Lac St. Jean region, the TÉVEC project, a two-year experiment in educational television by the Government of Quebec, served not just to teach adults in grades up to the ninth but also to "transform attitudes and broaden the spirit". In Thunder Bay, Ontario, the *Town Talk* citizen's group, using one of the spare channels on the city's cablevision system to provide community programming and discussion of local affairs, is "providing alternatives to the mass-media choice." And, again in Newfoundland, videotaped lectures, 'bicycled' between six outport communities (one 800 miles from the university campus), have made is possible for adults to follow a university-level course, 'The Psychology of Learning', and to pass with marks as high as students taking the same course in the university itself.

Less dramatically, the basic telephone, so long a part of the scene that even our grandparents took it for granted, is beginning to be used to bring men together in ways that are otherwise impossible: in a big city a lonely individual calls a Suicide Centre, and perhaps a life is saved; in New York, ghetto children use Touch-tone telephones and a programmed voice-response system to learn mathematics; and in Montreal, Sir George Williams University is using a similar method for language courses. The telephone has also made possible the 'Open-line' or 'Phone-in' radio show, affording another medium of self-expression to tens of thousands of Canadians who lack the skills or the self-confidence to express themselves in writing.

The technology of tomorrow could open up an entire new range of social and political opportunities. Arnold Rockman, a sociologist at York University, proposed the establishment of a series of 'citizens band'[6] television studios where members of the public could record messages and programs for later broadcast. Several participants advocated computerized referendums that could provide an instant feed-back of public opinion on national or local issues. Others called for the creation of 'demand-video' systems so that subscribers could call up particular programs or films they want to see, and thus be freed from the constraints of conventional television programming.

[6] Not to be confused with the so-called 'citizens band' in the United States, a special frequency band set aside for general radiocommunications.

Multi-channel systems are less expensive by several orders of magnitude than 'video-demand' systems. Amplifiers for 20-channel systems can be bought off the shelf today, and one 42-channel system is already in operation[7]. Charles Templeton, Vice President of CTV Television Network Ltd., saw cable systems becoming "virtually a utility . . . proliferating the number of channels, intensifying local programming and increasing the participation of the general public in broadcasting."

Video systems are relatively well known—even if, as in the case of video-cassettes, this is only because they have been massively publicized in the press. Much less familiar, undoubtedly because they have so far been developed almost exclusively for scientific, business and government purposes, are computerized databanks. One crucial problem of such systems—the potential threat to personal privacy—was the subject of a separate conference and is dealt with in the next Chapter. Discussion at the seminars therefore concentrated on the benefits rather than the possible dangers of databanks.

The key issue was how databanks might be used to make information that is of interest and of use to the public more widely and cheaply available. The most extended proposal was made by Diana Ironside, of the Ontario Institute for Studies in Education, who called for a network of databanks, suggesting that they might include:

> "currently and frequently updated information relating to availability and costs of a wide variety of consumer goods, educational opportunities, housing and real estate data, counselling centres, health services, welfare services, federal, provincial and municipal government services."

While a few participants argued strongly that governments should leave the development of information banks to private enterprise alone, many others favoured public financing in one form or another. In this connection, the point was made that unless governments take action to reduce communications costs, the advantages of computerized information systems would be available only in large urban centres, thus accentuating the disadvantaged status of other areas.

Between the promise and the reality of all this information technology, no matter how it is to be financed, is the barrier of cost. Vast sums would be needed for the creation of national computer utilities, or of a truly viewer-responsive broadcasting/communications system. A background paper prepared for the Seminar on 'Access to Information' calculated some of the probable annual costs for ultra-sophisticated systems installed in a model city of 26,000 homes: $2,100 per subscriber for a demand-video system; $2,600 per subscriber for a system of home-terminals to receive video output

[7] In San Jose, California.

from a computer; $1,600 per subscriber for a tele-typewriter installed in each home and linked to central computers. Videophones are now on trial in the United States at a monthly rental of $150; the cheapest of the home video-machines retails for $400. Expenditures of this magnitude have to be justified not only by the merits of the system itself but also in comparison with the potential benefits of similar expenditures on transportation, housing, or social welfare. Priorities are not always so rationally assigned, and many of the new communications systems are already on their way; theory, as so often happens, follows the facts. These new systems—and to use the term 'individualized communications systems' for those such as multi-channel cable systems and video-cassettes is to underline their difference in kind from conventional broadcasting—carry with them social implications which have to be balanced against the evident benefits of participation and freedom of choice.

Individualized communications systems, if widely available, might undermine the foundation of common experience and values upon which all societies are built. Jacques de Guise, a sociologist at Laval University, suggested that the global village of McLuhan may become rather a 'city of a thousand ghettos'. Jack Craine, Director of the CBC English Radio Network, pointing out that there are already more than 100 separate radio stations in Los Angeles and 90 in New York, echoed de Guise's concern:

> "In the world of one-station for one-listener, do we reduce the feeling of community which comes from this shared experience? The generation that will gain influence in the '80's will probably not mourn the disappearance of this mass experience. Instead do they see a world of city states with highly decentralized forms of government? All connected in isolation."

Peter Regenstreif, a political scientist at the University of Rochester, went further and suggested that a continual increase in the volume of information being made available might actually result in less effective information reaching the public. This phenomenon has been described as "narcotizing dysfunction"[8], and as Regenstreif explained:

> "the more time spent in listening, reading and viewing, the less time available for organized action. And the average citizen can easily mistake the fact that he knows a great deal with doing something about it."

Regenstreif amplified his caustic view of the prospects for participatory democracy by observing that the exotic new technology would be of little use to those groups who now participate least—the uneducated, the unem-

[8] Paul Lazarfeld and Robert Merton: 'Mass Communication, Popular Taste and Organized Social Action'; *The Communication of Ideas* (Harper and Bros., New York, 1948).

ployed, the very old, and the very young, since they are "so unaccustomed to dealing with the government and so fearful of any sort of interaction with it", and who would hardly be likely to lose their fears if confronted by a computer console instead of a civil servant. For most participants, however, the potential benefits of new techniques for participation far outweighed the potential dangers. As Donald Snowden, Director of the Extension Department at Memorial University, expressed it, any country that does not "as a deliberate act of policy", involve its citizens in the decision-making process, "is a nation with an especially regrettable dimension of poverty".

'Systems for people' has a fine ring to it, in theory. Practice is quite another matter. Out of all the debates and discussions, the Seminars produced three touchstones against which the value of communications systems, in terms of what society wants or seems to want, might be measured; these were 'access', 'alternatives', and 'education'.

Access to Information

Today, almost 96 per cent of Canadian households have television sets and 94 per cent have telephones. But many Canadians enjoy neither of these services. Moreover, where they are available, the amount of information that can be received and the cost of telephone service both vary widely from one part of the country to another. Bell Canada rates for basic home-telephones run from $3.45 to $6.95 a month in different areas, but the higher rate in a large city may afford toll-free access to several hundred times as many subscribers as the lower rate makes available in small communities. Disparities in television reception are even more glaring; while some urban residents can receive half a dozen or more channels on their ordinary home sets, many people in rural areas can receive television only by subscribing to CATV. At the same time, rural people pay, in the price of consumer products, for advertising carried by stations that serve only urban viewers.

Two proposals to equalize access to information were advanced: a flat rate for telephone calls regardless of distance; and subsidies to reduce data-transmission costs for users living outside the main urban areas. A suggestion for reducing the cost of information retrieval was that access to stored information might be provided by means of Touch-tone telephones, the material requested being sent through the mail, perhaps in microfiche[9] form. But 'access' in this context must be taken to include the capacity to send information as well as receive it; in the discussions on databanks and national information-retrieval systems, several participants suggested that 'neighbourhood terminals' for use by the general public might be set up, perhaps in Post Offices.

[9] Microfiche—a sheet of photographic film carrying a large number of micro-images.

Alternatives

Access puts individuals or groups into communications systems; what people get out of them obviously depends on the volume and kinds of information that the systems contain. If new systems can offer society the information it wants, the opportunity is there for wider public participation. One means of ensuring a wider choice of available information was proposed by Stuart Griffiths, President of Bushnell Communications Limited. He advocated the construction of a national 25-channel cable system which could be financed entirely by susbscription fees between $150 and $200 a year. "This is our last chance," Griffiths asserted, "to contruct a broadcasting system that is not dependent on advertising." Other participants pushed this idea several steps further. If freeing the broadcasting system from the control of advertisers is accepted as desirable, they argued, it may be even more desirable to free it also from the control of broadcasters themselves—or, in the parallel case of computer utilities, to free the information within the system from the control of those who operate the system itself. As Michael Harrison[10] explained, "there is a fundamental distinction between information content and the communications media which disseminate it." Some of the workshop groups translated this concept into tentative recommendations, such as:

> "Program and production entities and other users of the system should not be subject to the control of those responsible for the communications hardware."
>
> "Communications are becoming just as important as electricity and the government has to take steps to make sure that the people get the services on a par throughout the country. For this reason alone, the essential communications services should be a prime target for public utility regulation."

A quite different type of choice, this time provided by 'planning alternatives', was advocated by some of those at the seminars. As described earlier, a kind of technological imperative appears to have operated in the past, by which almost anything that could be imagined (intelligent machines, heart-transplants, supersonic transports) was inevitably invented and put into use, with little or no attempt to forecast the probable effects on the social, political, cultural, and natural environment. Although not even the most insistent technophobes at the seminars went so far as to propose a policy of 'zero technological growth', participants overwhelmingly demanded that major new developments such as videophones and computerized databanks be analyzed so that their probable environmental consequences could be identified in advance of their introduction.

[10] Vice-President, Tele-Information, Southam Press Limited.

Education

The communications revolution, Léon Dion suggested, has advanced to the point where "an audio-visual civilization is being substituted before our eyes for the civilization of the book". Books have survived the advent of television, and will no doubt survive computer/communications systems as well, but it is evident that the new technology is catalytically pervasive, and will become progressively more so. Several participants argued, for example, that the definitions of 'read' and 'write' will have to be extended to include an ability to read and write films, videotapes, and computer programs.

The relationship between information and education is as evident as that between information and political power. For information to become truly accessible, one participant said, "the new technology must be demystified." More specifically, Jack Craine proposed: "We must begin to train a new breed of activist listeners. Young people in the school system should be taught the simple technicalities of making their own shows." It was also emphasized that the designers of communications systems should be educated in the needs of those who will use them. The difficulty, as another workshop report noted, is that "people who are deprived of access to information are exactly the people who can't articulate their need for more." The solution recommended by the workshop was that those responsible for communications systems should undertake applied research in the areas where the systems will be used, in order to identify the true needs and wants of their intended users.

Summary

The seminars were intended as a starting point, a tentative beginning and no more. The area of discussion was too broad and the fund of knowledge too narrow for definitive or confident conclusions to be drawn. Many of the discussions were about processes rather than programs, attitudes rather than administrative solutions, means rather than ends. Contemplation of the navel offers an escape from decision-making, and there was quite a lot of it as academics, scientists, and assorted authorities tried to grapple with the problems of a future about which, as they candidly admitted, they knew so little. One exchange, recorded for posterity by a *rapporteur,* went as follows:

Engineer: "Tell us what you want so we can design systems to meet those needs."

Sociologist: "We don't know the answers. We have only just started to ask these questions."

Public Servants: "You are no more than liberals terrified by the overwhelming nature of the new technology. You ask an endless series of solemn questions, then you shake your heads and pretend that you don't have enough information to try to reply."

The seminars were designedly addressed to the formation of questions rather than answers, and the participants rarely paused to consider some of the more practical and prosaic issues. Most of the technology that is affecting society originates outside Canada and, wherever generated, responds more readily to market demands than to the hopes of government planners. Perhaps, and this may be the one clear-cut message to emerge from this Chapter, there are no replies of the easy well-defined kind that can be handled by the conventional mechanisms of government—reports, committees, resolutions, legislation, regulation. Instead, the mood of most participants was captured in the report of one of the workshop groups at the Arts Seminar:

"Discussed need to put soul in the system."

Conclusions

No resolutions were passed (or invited) at the seminars, no votes were taken; in their absence, the proposals of a polemicist could draw more attention than the views of a less vociferous majority. Despite these familiar difficulties of trying to capture the true mood of an unstructured meeting, certain themes emerged strongly. Some of these, which have already been mentioned, may be summarized here for convenience.

Under the general head of 'Access to Information', it was suggested that consideration might be given to the introduction of some form of flat-rate telephone charge, and to a similar approach to or subsidization of data-transmission rates, so as to equalize the benefits of access to national computer systems. Also proposed as a matter for policy consideration was the notion of establishing 'citizens-band' television studios, where groups and individuals could record programs and messages for later transmission to the public.

Many participants, dealing with the question of alternatives to services provided now or planned for the future, favoured separating the control of communications software, wherever possible, from the control of hardware; others went further and argued that all essential public communications services should be regulated as public utilities.

Two predominant themes emerged under the heading of 'education'. The first was that instruction in the use of the new technology, from film to computers, should begin at school, and courses for adults should also be offered. Secondly, there was widespread agreement on the need for designers of information systems, whether in government or industry, to determine the real needs of users, not as an afterthought but as an integral part of planning and building the systems.

There was widespread agreement that some means should be found to ensure that communications research, and the solution of communications

problems, should be undertaken by multi-disciplinary teams. Dale Thomson commented:

> "It is inconceivable to study communications and politics seriously without some competence in sociology, psychology, linguistics, mathematics, computer science, anthropology, and some of the natural sciences including biology, ecology and physics."

A recommendation put forward by the Seminar on the Wired City was that, in advance of any pilot project to test total communications systems in an urban environment, a multi-disciplinary task force should examine the issues from all aspects, such as the substitution of communications for transportation, or the psychological or sociological impact upon family life of a society in which housewives could shop from home, and in which children could educate themselves largely at home by means of educational television and computer-aided instruction.

A recommendation that emerged from all the seminar discussions was that consideration should be given to the establishment of some kind of Institute for Communications Research; the Arts Seminar more specifically recommended a Creative Communications Centre. Participants were wary of what was called the "almost inevitable bureaucratization of any institute" and wanted it to be free from governmental control, perhaps in the form of a 'think-tank'. However formed or named, its function would be to conduct both pure and mission-oriented research into the communications environment, and to criticize policies developed by government and industry, while perhaps performing an additional role as a source of trained manpower.

An expressed majority view was that some form of communications information service should be established. It is a *cliché* to say so, but those involved in communications are conspicuously poor communicators. Most of the 400 or so participants in the seminars were strangers to each other, and there was a consensus that an information service would link all those in the field into a larger collectivity, in addition to the obvious benefits of a centralized store of information and the elimination of duplication in research.

The right of personal privacy, which is the subject of the next Chapter, was also a matter of concern at the seminars. Another aspect of personal privacy, that of protection against 'information-overload', was discussed, and one participant proposed that "any future Wired City should include silent rooms where citizens could go to escape from communications systems."

However, the predominant theme underlying nearly all the discussions at the seminars was that the 'right to communicate' should be regarded as a basic human right. In the impending age of total communications, the rights of assembly and free speech may no longer suffice. Many people are unable to communicate; they do not receive the messages distributed by communications systems, they lack the know-how to use them, and above all they are deprived of opportunity to send messages through them. The basic decisions that govern the development of communications systems are political; therefore, if all Canadians are to be provided with the minimum services needed

for the exercise of a 'right to communicate', political decisions and money will be required.

Even if some new record were established, and all the recommendations and suggestions put forward at the seminars were to be implemented, one fundamental problem would remain. It was evident that most participants were deeply concerned with "the need to put soul in the system." The meaning behind this concept slips through the net of words, for as Meredith said:

> "Ah, what a dusty answer gets the soul,
> When hot for certainties in this our life!"

CHAPTER 4

The Human Goldfish

The idea of a socio-political 'right to communicate' has its counterpart in that of a 'right to privacy', which has recently been the subject of mounting public interest and discussion, particularly in connection with telecommunications and computerized databanks. The concept of privacy, in this context, is relatively new. At the international level, both the Universal Declaration of Human Rights and the Covenant on Civil and Political Rights contain provisions to protect the individual against illegal or unwarranted interference in his private affairs. In Canada, the legal recognition of a right to privacy has generally been implicit rather than explicit, although there are laws that incorporate certain fundamental human rights closely associated with the idea of a right to privacy. There are, for example, laws of property and trespass, laws of libel and slander, laws governing the confidential nature of information in certain situations, and laws respecting the monitoring of telephone conversations and tampering with the mail. The Radio Act also contains provisions designed to protect the public from the effects of improper use of radio messages.

The new emphasis on the demand for privacy arises from the technological possibility of storing, manipulating, and distributing all information, whether useful or not, and the presumption that stored information will eventually be used, legitimately or not, unless proper safeguards are provided. In fact, growing public concern is identifiable, in large part, as a reaction to the accumulation of instantly accessible personal information stored in computerized databanks. There is no getting away from the fact that people intuitively dislike the idea that comprehensive information about all their affairs should be available to someone else at the push of a button.

Few people would challenge the need for positive identification in a variety of circumstances. Hardly anybody seriously objects to having a whole series of numbers for such purposes as social security, health insurance, driving licences, passports, and credit cards. Most people also understand the administrative economies that could be effected in this age of computers if each person had only one all-purpose number. In the range between being identified by many numbers or one, the threshhold of the demand for privacy is reached at the point where reason gives way to intuition. The idea, which

cannot be supported by reason, seems to be that absolutely positive identification destroys the sense of personal identity; in the words of Mallarmé, "Définir, c'est détruire".

Behind increasing public discussion and pressures for government action against 'invasion of privacy', people often mean different things by privacy. Everybody seems to be in favour of privacy as an abstract concept, just as everybody is in favour of such other abstract concepts as 'freedom of information' or 'freedom of expression' when seen in isolation. But the abstract is not the real, and standards of behaviour can often be established only by arriving at unwelcome compromises between divergent interests.

Here, then, is the dilemma. Those who advocate the establishment of privacy as a human right, while admitting that total withdrawal from society is impossible, argue that the individual should have the right to be alone, to disconnect. Others maintain that the public 'right to know' should take precedence of the individual 'right to be private'; they see the so-called 'right to privacy' as an elitist attitude towards the power of information, especially information about rich and powerful people. This kind of analysis leads to questions about the privacy of the disadvantaged. How much privacy can be enjoyed by the welfare recipient, the out-patient at a public clinic, or the indigent senior citizen? The point is valid, although in practice it may be easier for a relatively poor person to withdraw from society, if only because he has a better chance of not being included in any databank at all. The rich and powerful may also have more to hide; for information that might destroy a career in some walks of life could be a matter of indifference in others. At the turn of the century, when crude practical jokes were all the rage in England, a notorious prankster sent telegrams to all the bishops and deans of the Church of England, saying "Fly at once—all is discovered"; 17 prelates caught the next boat from Dover to Calais. Often it is not sin that causes anxiety, but rather the fear of being found out. In short, it could be argued that the less one has and the less one does, the less reason to fear the universal-access all-purpose computerized databank.

Some of these difficult questions underlay the discussions at a conference on 'Computers, Privacy and Freedom of Information'[1] held in May, 1970, which had more specific terms of reference than the general question of the right to privacy.

Computerized databanks and information systems make it possible to gather, consolidate, and use information about people that would have been, for all practical purposes, irretrievable in the age of manually operated filing cabinets and index cards. The point was put neatly by Dr. John Deutsch, Principal of Queen's University, who was chairman of the Conference panel on legal and social aspects of privacy:

> "In the past, we've had a protection from the limitations of the written word. While a lot of information could be collected, it was cumber-

[1] see Introduction to Part II.

> some, it was difficult to find, certainly difficult to find quickly, and this has given the individual a good deal of protection as far as privacy is concerned. It was like looking for a needle in a haystack. Well, what's happened now is that we can indeed find the needle."

The advantages, for police work and other legitimate purposes, are obvious and substantial. But, now, detailed and categorized information about masses of people is becoming a saleable commodity, and there is already a fairly wide commercial market for information about the health and credit, and even the socio-psychological characteristics, of individuals. Apart from the intuitive fear of being treated as a number instead of as a person, a matter of legitimate concern is the fact that the mobility of data in electronic systems makes unauthorized or undesirable use of personal information more difficult to control. Concern may develop into a sense of outrage if the information is erroneous. It was therefore argued that a person should be entitled to verify the accuracy and objectivity of information about his affairs that may have to be disclosed, for one or another legitimate reason, to others. Possible safeguards and remedies fall into three complementary categories—statutory, regulatory, and mechanical or electronic—which were discussed from a variety of angles.

Few participants at the Conference contested the complexity of computerized information systems, their awesome efficiency, and their potential impact on human activities and aspirations. Against the undoubted benefits they may provide must be set fears of subjection to the machine, anxiety about the atrophy of individual powers of decision, and apprehensions of a rigidly enforced conformity in a world where everything is known. It was also argued that the real threat is not that the privacy of the individual may be invaded, but that more abundant information and improved communications systems tend only to reinforce the powerful.

Further, it was suggested that, since governments might be in a better position to apply security controls to electronically stored information than to documents in public archives, the public right to public information could be jeopardized. This was undoubtedly a minority view, and the need for safeguards was stressed by many of the participating businessmen, systems designers, academics, and government officials. Most of the suggestions went far beyond what is now required by law, and the number and variety of reforms proposed was an indication of the complexity of the problem.

The Minister of Justice linked the threats of electronic eavesdropping with the great potential of computerized systems for manipulating and integrating information. One clear danger is that a number of separate files containing personal information freely given may, by the mere fact of computerized integration, result in personal dossiers that individuals, had they been asked, might never have been willing to authorize. For the same reason,

many existing but separate information systems would, by being computerized, instantly become more formidable instruments of power.

Almost unanimous agreement was reached on the need for some form of greater protection of privacy, not necessarily on an unconditional basis. Difficulty was experienced in defining privacy, either as a legal or philosophical concept. While some participants felt that definitions should be left to the courts on an *ad hoc* basis, others believed that they should be embodied in federal and provincial law. It was, however, generally accepted that the legalization of a right to privacy should be tempered by recognition of the need for freedom of access to information. Computer/communications systems based on databanks are becoming essential tools for planning, research, and commerce, which should not be subjected to unreasonable restrictions. Freedom of access to government information was also a concern, and it was suggested that consideration be given to legislation on the lines of the Freedom of Information Act in the United States.

While there was a predominant opinion that the computer, by facilitating very much faster searching of more comprehensive files, has altered the dimensions of the privacy problem, it was also generally agreed that the technology affords opportunity for security controls more effective than those that can be imposed on a manual system. It was suggested that, to avoid unnecessary or undesirable restrictions of access to information, security standards for databanks should be directly related to the nature of the information stored, even if this necessitated an uneconomic segregation of databank types. Nevertheless, fears were expressed that security controls have not yet been developed to the point where they can be relied upon to ensure impregnability.

A participant from the United States[2] pointed out that there is no identifiable 'databank industry', as there is an 'automobile industry' or a 'motion-picture industry', which might be capable of self-discipline. In proposing the creation of a regulatory agency to establish security standards, to licence databank operators, and to exercise surveillance of their operations, he said:

> "Consider what can happen if databanks proliferate widely and without control. We see all around us situations that were recognized after the fact and are now out of control and harmful to society; the many kinds of pollution are a prominent example. Protection of the individual's privacy and reputation is already recognized as essential to society's health; I would rather not have databanks become the problem that pollution has. Thus, my view is that we should vigorously and agressively formulate appropriate safeguards, mechanisms, and legislation. Let's try to be ahead of the situation before it is too late."

One participant[3] in advocating the licensing of databanks as such, proposed the creation of 'restricted classes' of information, the enforcement of cut-off dates for the elimination of 'stale' information, regulation of domestic and

[2] Dr. Willis H. Ware, Rand Corporation.
[3] Professor J. M. Sharp, University of Manitoba.

international links between databanks, regulation of the sale and disposal of information, and an individual right (subject to certain restrictions) to verify relevant personal records and to demand the rectification of error. Some protection could be afforded by legal requirements for cryptography in transmission, scrambled storage, and random external auditing of record use and program changes.

As a basis for control, a classification system was proposed[4] with three principal sets of variables—data source (public record, supplied by individuals, or other sources); distribution (internal, external); and inspection (automatic, request of individual, forbidden). A personal credit file, for example, might be classified OER (Other sources; External distribution; access on Request); this would indicate that the information came from sources other than public record or the subject individual; that it could be used outside the information system; and that print-outs are mandatory on the request of the subject individual. A police file might be classified OEF, the difference being that the supply of a print-out to the subject individual would be forbidden. However, two of the Conference workshops proposed that all government files, including police files, should be open to the subject individual on request.

An instance of government information that might be jeopardized if access were free to all is provided by the Canadian Statistics Act, which guarantees that no individual will be harmed as a result of compliance with the Act in providing information to the Dominion Bureau of Statistics. Despite precautionary measures to make this guarantee effective, difficulties sometimes arise when two or more sets of data, read in conjunction, permit indentification by unmistakable inference. Similarly, personal or corporate information stored in a computerized databank may be identifiable even if the name of the subject is not disclosed.

There was widespread opinion that a legal concept of 'invasion of privacy' should be introduced into Canadian federal and provincial law, although it was recognized that effective control would entail heavy administrative and technical expenditures, which might indeed be so great as to inhibit the development of socially desirable information systems. Nevertheless, a widely accepted view was that the 'right to communicate' should imply a complementary right not to be communicated about involuntarily, a recognition that there exists a private 'domain', within which the individual will either refuse to communicate, or will do so only reluctantly and to a limited audience. There is no simple answer to the nature of this 'domain', which entails the desire to be left in peace by one's neighbours and the community, to be detached or offbeat, to be anonymous in public,

[4] Professor Calvin C. Gotlieb, University of Toronto.

to communicate confidentially—in short, to disconnect at will. These needs are, for many people, basic to personal equilibrium and peace of mind.

Several proposals were put forward for a commission, or a tribunal, or an ombudsman, empowered to consider complaints and injuries arising out of the misuse of information. Other powers proposed ranged variously over the whole gamut of advice, research, establishment of professional and technical standards, licensing, interchange and collation agreements, and surveillance. Options suggested included parallel federal and provincial bodies, a joint federal/provincial body, and bodies including representatives of operating and user industries, universities, consumer associations, and civil liberties groups. There was almost universal agreement on the need for some form of licensing or registration of databanks related to a classification of the information stored.

Proposals for legislative or regulatory measures included, in addition to the general 'right to privacy', the establishment (under appropriate federal and provincial laws) of civil or criminal liability and damages for misuse of information, an absolute right to review stored information by the subject person, and a reasonable individual right to restrict access to a personal file. There was also widespread support for the opinion that any rules that may be established should apply with equal force to government databanks and information, whatever their nature.

Finally, it would appear that many of the participants—for all their erudition and distinction, but with evident justification—felt, in the words of the Psalmist, that "Such knowledge is too wonderful for me; it is high, I cannot attain unto it." This view was reflected in the majority recommendation that a special task force be established to review current practices and laws, and the extent to which personal information is now stored, disseminated, and used; to identify special areas of concern and propose definitions for such concepts as privacy, databanks, and information systems; to study the constitutional and legal issues involved; and to make recommendations for future policy and legislation.

It is questionable, however, whether an immediate full-scale frontal attack on these problems is likely to produce dramatic results. While the subject clearly merits increasing attention and urgent investigation, the Conference was informed that, for example, no credit records have yet been computerized in Canada, so far as is known. The problems of invasion of privacy and improper disclosure of information already exist in a less pervasive form, not only with regard to credit but to many other kinds of information. It could, therefore, be argued that it would be premature to concentrate too much attention on locking the stable door before there is a horse inside, and that the first requirements are to gather and assess, as thoroughly and as quickly as possible, all the facts necessary to evaluate the

seriousness of the new threat to privacy that may be presented by computerized data systems. On the basis of these facts, it should be possible to determine the practicability of establishing a legal right to privacy and the ways in which it could be effectively protected.

CHAPTER 5

Databank Dialogue

> "Mechanization has emphasized complexity and confusion; it has been responsible for monopolies in the field of knowledge; and it becomes extremely important to any civilization, if it is not to succumb to the influence of this monopoly of knowledge, to make some critical survey and report. The conditions of freedom of thought are in danger of being destroyed by science, technology, and the mechanization of knowledge, and with them, Western civilization."
>
> HAROLD A. INNIS[1]

Throughout all the discussions of computers and privacy there was a recurring emphasis on the need to establish some kind of 'right' of access to information. This took the form of insistence that whatever reasonable safeguards might be devised for the protection of personal information against misuse must be accompanied by equally effective safeguards against improper denial of access to knowledge. The need for both kinds of safeguard is not new, but has been intensified by the development of telecommunications systems that afford instant remote access to computerized databanks in which any information can be stored; for the technology that makes universal access feasible also affords more effective means to restrict or deny access to information that should be available to all.

Some participants in the Telecommission studies have argued that governments have no place in the databanks of the nation. The opposite view finds its justification in the fact that, at least since the invention of writing, governments have been concerned to make information available to the public through the establishment and support of libraries, archives, and information services, all of which may be defined as public databanks even if they are manually operated. The developing technology of information storage and retrieval has added a new dimension to these concerns, as they affect Canadian governments, by the opportunities that may be developed for making more information readily available, in both English and French to people anywhere in Canada.

A distinction can be drawn between information of universal value and interest, and information that is primarily the concern of a particular society or community. In either class, information may be under some form of private control or in the public domain. A further distinction relates to the

[1] *The Bias of Communication*'—University of Toronto Press, 1964.

useful life of information, which may be of ephemeral or permanent interest, or anywhere in between. In every case, computerization and facilities for remote access may contribute to the solution of problems of one kind or another which are becoming increasingly intractable, but may also generate new problems.

The physical housing of documentary records and books is becoming an inexorable problem for governments, universities, and public libraries alike. The archivist making difficult judgments about the retention or destruction of records is often influenced, by lack of storage space, to destroy rather than preserve in marginal cases; the relief afforded by microfilming may, in the future, be greatly extended by resorting to electronic storage, with the assurance of ready access that is provided by computerized cataloguing. Even so, the high cost of computerizing information necessitates a continuing exercise of subjective judgment as to the value of documentary records in terms of historical interest and in the context of a national public 'right to be informed'.

Librarians face similar problems in deciding on acquisitions and discards, for limited storage space may demand that something must go if anything new is to come in. The axe is unlikely to fall on the works of Aristotle, Shakespeare, or Einstein (which are of course widely available elsewhere) but rather on some book by a little-known author or an obscure doctoral thesis, either of which may be the only extant copy and may contain some thought of enduring value or information important to research in a particular field. Moreover, the new technology will also have its effects on acquisition policy, for there are thousands of books which, although essential for occasional reference or special research, are required by relatively few people at the same time; their acquisition may be deemed unnecessary if they are known to be available elsewhere and instantly accessible by electronic means.

The possibility of developing a Canadian network of libraries available for remote access by random readers merits some serious consideration by governments on several grounds. The largest university libraries in Canada, for example, are dwarfed by many of their counterparts in other countries, and immense expenditures would be required, both for buildings and books, if this disparity were to be reduced by traditional methods of expansion. Indeed the cost of books, ever increasing, even in paperback, is a significant component of rapidly rising expenditures on education. It was estimated in 1968[2] that, in the ensuing decade, Canadian university libraries would spend $526 million on acquisitions alone and that an additional $150 million would be necessary to bring them up to the minimum level that will be needed by 1978. Thus, if books were available in computer memories or video-cassettes,

[2] *Resources of Canadian Academic and Research Libraries,* Robert B. Downs (Association of Universities and Colleges of Canada, 1968).

and available simultaneously, on demand, to readers anywhere in Canada through telecommunications links, substantial savings in public expenditure might be effected. The advantages are particularly relevant in Canada, where the need for comprehensive libraries of works in both English and French, which should eventually be ubiquitous, is becoming daily more and more urgent.

It is necessary, however, to introduce here a cautionary note against unrealistic expectations, for there are technical problems yet to be resolved, and the reduction of costs to a practical level will take many years of technological development. So far as storage of library-type information is concerned, an acceleration of practical possibilities can be foreseen as a result of the successful development of the video-cassette; it will be recalled that a single cassette can accommodate as many as 500 novels of average length recorded at a page per frame. The obstacle of high costs for long-distance transmission also remains to be surmounted, but the development of the Canadian satellite-communications system may, in time, lead at least some of the way towards the eventual levelling out that was so strongly advocated by many participants in the Telecommission seminars on the social aspects of telecommunications development in Canada. This vision of a universal access library network is almost certainly not illusory, but its realization may take 20 years or more and may never be achieved unless plans are put in hand now for action to be taken relatively soon.

Rather different considerations apply to the storage and accessibility of information that is primarily of interest to a particular society or community. The first is that necessary or highly desirable information may not be available to the public at all if the society or community does not concern itself with its collection, organization, and distribution. Secondly, if the storage and availability of valuable information is left entirely to private enterprise, a financial interest is likely to be created in that part of the information that has a realizable commercial value, while wide areas of socially valuable information may not be available at all. In Canada, these considerations are equally the concern of the federal, provincial, and local governments, each in its own sphere of particular interest.

For Canada, special problems of national interest are created by proximity to the United States, where economies of scale in the establishment of computerized databanks often more than offset the transmission costs entailed in remote multiple access, giving rise to a perceptible trend towards the establishment of a north-south axis for information systems, which will be further explored in Chapter 15. One example of the storage of important Canadian information exclusively in a foreign databank is the reliance of the Canadian insurance industry on computerized information located in Hartford, Connecticut. Canadian makers and purveyors of hardware (to use the term, for once, in its traditional sense) who want essential information about prices and available stocks use a central databank in Columbus, Ohio, which also offers business services (payroll, billing, etc.) of a more general kind that could otherwise be obtained in Canada. All essential information about real-

estate in four large Canadian cities is held in a databank in Detroit, and other instances could be cited. Each, regarded in isolation, may not seem to be cause for undue concern, for this may be the most economical approach for any particular Canadian industry, and restriction of access to basic data is unlikely in any circumstances that can reasonably be foreseen; the danger lies in the capability of the computer to co-ordinate and manipulate the information it stores so as to develop business applications not particularly relevant to Canadian conditions, thus placing the domestic industry at a disadvantage with its competitors in the United States. Perhaps the most disturbing example of this trend is the storage outside Canada of vital information about Canadian natural resources.

Some of these problems were examined in a Telecommunication study[3] addressed to the international transfer and foreign storage of computer-data vital to Canadian interests, in which they were characterized as political or legal. The political aspects include the possibility of interference by a foreign government with the flow of information or restriction of access to data owned in Canada. The principal legal problems appear to be those of determining proprietary rights and interests in information, especially intellectual property rights, in which the international aspects are, in effect, an extension of problems yet to be domestically resolved. The conclusion was that international safeguards could most feasibly be achieved by means of bilateral or multilateral international agreements. These are perhaps most necessary in relation to the opportunities that satellite communications afford for the misuse or misappropriation of messages or broadcast programs, which are discussed in Chapter 9.

The mounting capability of technology to undermine measures for the protection of intellectual property is creating difficulties that are different not in kind but in dimension. For example, some authors have long complained that the acquisition and circulation of their works by public libraries deprives them of rewards to which they feel reasonably entitled, and various proposals, mostly unpractical, are made from time to time for some form of royalty to be based on the usage of books as distinct from their purchase. The problem will clearly be aggravated in the age of computerized information-transfer unless some effective protection can be devised. A solution may eventually arise if there is ever a realization of the concept of a 'cashless society', where every expenditure is instantly debited and credited to the appropriate accounts stored in remote-access computers. In that event, copyright owners and proprietors of information could be sitting pretty; for the action by the reader that summons any information for review could simultaneously record a small charge to the caller and a corresponding credit to the proprietor.

[3] Telecommission Study 3 (c)

In the meantime, however, there is little reason to doubt that difficulties and antagonisms will increase, as existing protective measures are progressively eroded by new technology, before satisfactory solutions are found, and no specifically Canadian remedy yet appears imminent. The problem is, as has been said, partly international in character, and Canada will be represented at several forthcoming conferences on the protection of intellectual property under the auspices of such bodies as UNESCO, the United International Bureaux for the Protection of Intellectual Property (BIRPI), and its successor organization, the World Intellectual Property Organization (WIPO).

Some account has been given of suggestions for public databanks offering information services of current interest in a particular community. The only thing new about this idea is the means. It has long been possible, in many places, to use the telephone to find out the time or hear a recorded news or weather report; in Geneva, in fact, by dialling 11 an operator can be reached who will give information requested on any subject. Information about consumer prices, real estate, and job opportunities is widely disseminated by and is a source of revenue for newspapers, which in themselves represent an ephemeral form of databank.

Some computer experts believe that newspapers will eventually become obsolete, giving place to video displays summoned at will through a universal-access omniscient computer/communications network, the construction of which may have to be promoted by governmental action.

There are, nonetheless, many kinds of useful or even essential information services which governments or communities might undertake to provide because they are not now, or likely to become, commercially remunerative, or because their availability is restricted so as to further the private interest of their purveyors. Some examples in the first class include up-to-date information about educational opportunities, health and welfare services, and local group activities in the arts and amateur sports. Even here, however, until a universal-access computer/communications network has been realized, there is little that can usefully be done beyond some possible enlargement of the fairly common practice of sponsoring announcements in the press and in broadcasts.

At present, the most rapidly developing public uses of computers for the storage and retrieval of information appear to be in the accumulation of formerly dispersed information, and in the cataloguing and cross-referencing of sources of inter-related information. The Government of Ontario, for example, has recently introduced a new computer service offering, from a central source, consolidated information on registered debts of Ontario residents, which could formerly be ascertained only by individual search through records available in 48 county and district offices; the system,

using the computer that now keeps track of drivers' permits and vehicle registrations, will not be fully operational until early in 1974.

In the scientific and medical fields, computerized databanks are being built up that will vastly facilitate the correlation and retrieval of widely spread information on particular subjects, and many museums and libraries are at last beginning to catch up with cataloguing delays that are inevitable in large institutions if only manual methods are available. Some of this information is already accessible through the communications networks, and the eventual advantages to the community need hardly be underlined. However, the cost elements of electronic information systems are a limiting factor on the rapid attainment, so clearly in the public interest, of the benefits to be derived from applications in which analytical cross-referencing, comparative information from dispersed data, and the ease and immediacy of retrieval are supremely important.

One clear feature that emerges from these discussions is that in Canada, as on the international scene, governments—federal, provincial, and local alike—have a common interest in avoiding unnecessary duplication of computer-stored information, and in making plans now to ensure its availability in the long run, through remote-access communications facilities, to the feasibly largest number of Canadians in all parts of the country at a reasonable price. In Canada the need for this kind of collaborative planning is perhaps more urgent than in many other countries, for the distances between communities are often great, and the volume of information to be made available is enlarged by the requirement that much of it must necessarily be available in both English and French.

PART III

Telecommunications Today

Canadians have become accustomed to telecommunications services—telephones, telegraphs, broadcasting—which are taken for granted and expected to work well. Here is an account of how those services developed, of the organisms that provide them, and of their extent. On the international scene, Canada participates in activities that help to make those services available in all parts of the world, including especially countries that do not yet enjoy their benefits to the full.

CHAPTER 6

Smoke Signals to Satellites

The problems of communicating over a distance have engaged the ingenuity of man from prehistoric times. Precursors of the electric telegraph were the smoke signals of the North American Indian, the network of hilltop beacons in England reporting the sighting of the Spanish Armada, the array of flags at sea, the mechanical semaphore, and the heliograph. All depended on the use of some kind of code, and all (like microwave transmission systems today) were operable only over lines of sight. In the transmission of audible messages, the jungle drum, the alpenhorn, the trumpet, and the bugle also use codes but do not require line of sight. In all these systems, the range of transmission is limited only by the practicability of setting up relay stations. The revolutionary breakthrough achieved by the electric telegraph and the telephone was that communication over a distance was no longer restricted by the perceptive capacity of the human eye or ear.

In 1846, about two years after the feasibility of the electric telegraph had been demonstrated in the United States by Samuel B. Morse, the first commercial system in Canada was brought into use between Toronto and Niagara; one of the messages sent on the opening day was a dunning notice on an overdue bill. In 1847, the first Canadian telegraph service was connected to systems in the United States by a line from Niagara to Buffalo, and several new companies were incorporated. Among these was the Montreal Telegraph Company, connecting Toronto, Montreal and Quebec City, which rapidly extended its coverage by amalgamation with many smaller companies throughout Ontario, Quebec, and the maritime provinces. A Canadian first, at least in North America, was the submarine cable laid in 1852 between New Brunswick and Prince Edward Island. A cable laid four years later between Ireland and Newfoundland soon failed, and it was not until 1866 that the first effective trans-Atlantic cable came into use for telegraph service. In 1881 amalgamation of the Montreal Telegraph Company with the Great North Western Telegraph Company, which had been formed in 1880 to provide service west of the Great Lakes, resulted temporarily in a virtual telegraph monopoly throughout eastern Canada.

Although the first Canadian railway had also been opened in 1846, the early telegraph companies were mostly developed as independent under-

takings. The Government of Nova Scotia was in the business in the 1850's, and the federal Government constructed 1,300 miles of line from the Lakehead to Edmonton between 1872 and 1878. The federal network was extended, following the gold rush, into the Cariboo, the Klondike, and the Yukon, and eventually into the eastern and maritime provinces; cables to the Magdalen Islands and Grand Manan were laid in 1880.

British Columbia had been, since 1864, the beneficiary of telegraph lines built as part of a project for telegraphic connection between the United States and Europe *via* Alaska and Siberia, which was abandoned after the laying of a successful trans-Atlantic cable in 1866. The federal Government acquired these lines in British Columbia in 1880. The federal services, originally under the Department of Public Works, continued to be operated by the Department of Transport until, following a decision taken in 1950, they were progressively turned over to provincial and commercial carriers.

The year 1880 was marked by two events which had most important consequences for the development of Canadian telecommunications—the incorporation of the Bell Telephone Company of Canada, and the beginning of telegraph construction by the Canadian Pacific Railway, which was empowered by its charter to conduct a commercial telegraph business; this led to the completion, by 1886, of the first all-Canadian telegraph route from coast to coast. Other railway companies developed commercial telegraph services along their rights of way, some of which are still in operation[1].

There is no place here to describe the amalgamations and complex manoeuvres that led to the formation of the Canadian National Railways between 1917 and 1921, but the consolidation of the telegraph services of the constituent companies was the foundation of Canadian National Telecommunications (CNT) as a component of the new system. CNT acquired the independently operated Grand Trunk Pacific Telegraph Company in 1928, and the land-lines of Western Union in British Columbia and the maritime provinces in 1924 and 1929 respectively. In 1947, CNT and Canadian Pacific Telecommunications (CPT) made a formal agreement covering joint provision of certain private-line services, regularizing arrangements that had developed as a matter of convenience during the 1930's. The two companies continued their public message-telegraph services competitively, but diminishing revenues and rising costs led to a plan, approved by the Canadian Transport Commission in 1967, for the reciprocal abandonment of local offices. The two services, now completely integrated, are operated as a consortium under the name of CN/CP Telecommunications (CN/CPT).

[1] Notably Algoma Central; Nipissing Central; Northern Alberta; Ontario Northland; Pacific Great Eastern; and Quebec North Shore and Labrador.

MAJOR TELECOMMUNICATIONS TRUNK ROUTES

The first telephone communication in history was made, as every schoolchild knows, between Paris, Ontario, and Brantford in 1876 by Alexander Graham Bell. The first telephone exchange in Canada was opened in Hamilton in 1878, two years before the incorporation of the company now known as Bell Canada, which quickly extended its operations into every province except British Columbia. At the same time private companies proliferated in the eastern provinces, and Bell, under pressure in raising the necessary large amounts of capital, disposed of its lines in the Maritimes in 1888. Progress was slower in the prairies, where costs were higher; exchanges existed only in the larger towns and were unable to provide connections to the widespread agricultural settlements demanding service. In Manitoba, municipalities were empowered to own and operate telephone exchanges in 1899; six years later the provincial Government assumed power to operate services and acquired all the Bell facilities in the Province. Similar powers were assumed by Saskatchewan and Alberta soon after their accession to provincial status; the Bell facilities in those provinces were acquired by the provincial Governments in 1909 and 1908 respectively.

In British Columbia, private telephone companies were in operation from 1880, and a cable connection was made with Vancouver Island; from 1904, the British Columbia Telephone Company gradually acquired a dominant position by absorbing most of the small private companies in the Province. The first telephone exchange in Newfoundland was opened in 1895 by a private company, and today the Newfoundland (formerly Avalon) Telephone Company serves most of the more heavily populated areas. Before 1949, the Newfoundland Government served some of the more remote parts of the island through a branch of its Post Office; on accession to Canada, these telephone services (as well as the local telegraph service) were taken over and are still operated by CNT.

Although there are nearly 1,900 telephone undertakings in Canada, the telephone service works, generally with a high degree of efficiency, as a cohesive whole. The effectiveness of the service is the outcome of a prodigious cooperative enterprise, known as the Trans-Canada Telephone System[2], undertaken by a group of provincially-owned undertakings and commercial companies under the informal but vigorous leadership of Bell Canada. Equipment and operating standards are compatible with those in use in the United States, with the result that there has been little lag in the introduction of new technology. The installation of automatic dialing began in 1924, although it was not until 1928 that an all-Canadian line between Montreal and Winnipeg was completed. Direct Distance Dialing was introduced in 1956, and over 98 per cent of Canadian subscribers now enjoy automatic service. Today, a

2 For a description of the Trans-Canada Telephone System, see Chapter 7.

Canadian telephone subscriber who wants to speak to somebody else at a distance has virtually the whole world at his fingertips.

The Canadian Overseas Telecommunications Corporation (COTC) was incorporated by statute in 1949[3] to acquire the assets in Canada of Cable and Wireless Limited and some of those of the Canadian Marconi company, and to provide and operate overseas telecommunications links. COTC provides telephone and telegraph service to most parts of the world, other than the United States, through interconnections with the global networks of submarine cables, high-frequency radio circuits and, more recently, satellite circuits, linking all continents. In 1953, COTC entered into an agreement with the British Post Office and the American Telephone and Telegraph Company (AT&T) for the installation of the first trans-Atlantic telephone cable, and has continued to participate in the development of submarine cables across the Atlantic and Pacific Oceans.

Newfoundland was the scene of an historic occasion when, in 1901, radio signals transmitted from Poldhu in England were received in St. John's by Guglielmo Marconi in person. This first successful long-distance use of radiocommunication was the forerunner of a technological revolution in communications which has changed the face of the world. At first radio, like other telegraph systems, was seen only as a means of point-to-point transmission of coded messages. From 1909 until 1930 (when short-wave transmission became available) Canada provided radio service to ships of all nations in the North Atlantic from Cape Race, the most easterly radio station in North America.

In 1913, when the use of radio for voice transmissions was more clearly foreseen, the federal Wireless Telegraph Act of 1905 was replaced by the Radio Telegraph Act, which applied to "any wireless system for conveying electric signals or messages, including radio telephones". A telephone service between Canada and Europe *via* New York was inaugurated in 1927, service to ships at sea began in 1929, and in 1933 a direct channel between Montreal and London provided service to Europe, Asia, Africa and Australia. But it was not until 1938 that a link was established enabling Newfoundlanders to make telephone connections outside the island. The Trans-Canada Telephone System[4] has established two coast-to-coast microwave systems involving some 25,000 route-miles of microwave channels during the past 15 years. Another coast-to-coast microwave relay system was built in 1961-63 under the joint ownership and control of CNT and CPT, and is now operated by CN/CPT.

The rapid development of satellite communications is of immense importance to Canada. The capacity of the communications satellite for

[3] For further details about the incorporation of COTC, see Chapter 7.
[4] see Chapter 7.

carrying high-quality telephone, television, and data-transfer signals between widely separated points is peculiarly relevant to the geography and demography of Canada, both in supplementing terrestrial connections between urban centres and, even more importantly, by bringing telecommunications services to scattered and otherwise inaccessible communities, particularly in the north. Canada is a member of the international consortium known as INTELSAT[5]. COTC was designated to participate financially in the venture, and operates the associated earth-stations in Canada.

Telesat Canada was incorporated by statute in 1969[6] to provide domestic satellite communications, with provision for share-ownership by the federal Government, the Canadian telecommunications carriers, and private investors. Anik—the first domestic commercial geostationary communications-satellite in the world—is to be launched in 1972, and tenders have been invited for the construction of the first earth-stations.

Broadcasting is, by statute, distinguished from other forms of radiocommunication by the fact that broadcast transmissions are intended for direct reception by the general public. The use of radiocommunications for this purpose preceded the general introduction of the radio telephone. The first broadcasting licence in Canada was issued in 1919 for the (English-language) Montreal radio station now known as CFCF, and three years later regulations for licensing private commercial broadcasting stations were made under the Radio Telegraph Act. Development was rapid, and 80 broadcasting licences had been issued by 1930, but Canadian broadcasters suffered great difficulties from interference by stations in the United States and Mexico using identical or adjacent wavelengths; it was not until 1932 that a reasonably satisfactory accommodation was achieved by an agreement with the United States. Although television became technically feasible in the mid-1930's and broadcasts started on an experimental basis, regular public service did not begin until 1952.

An interesting historical aside is the following account[7] of the circumstances in the earliest days of Canadian broadcasting that contributed to the decision to establish a public broadcasting service:

> "Complaints were raised regarding the amount of advertising carried by licensees. The lack of live originations from local stations, the constant use of recorded material, and the failure of station operators to make good use of Canadian talent, were some of the criticisms directed against broadcasting during the 1920's. There was also the fear that the lack of east to west communications via radio, and the increasing use of programmes from the United States would have an injurious effect on Canadian unity."

[5] see Chapter 8.
[6] For further details about the incorporation of Telesat Canada, see Chapter 7.
[7] Report of the Royal Commission on Broadcasting, 1957.

Following the report of the 1928-1929 Royal Commission on Radio Broadcasting (the Aird Commission), articulate public opinion moved in favour of the establishment of a national system of broadcasting. The outcome, in 1932, was an Act which established the Canadian Radio Broadcasting Commission to provide a national broadcasting service and to regulate all broadcasting in Canada. In its first year, the Commission had a budget of only $1 million to cover the cost of capital improvements and operations, wireline charges for network broadcasting, and the provision of opportunity for the development of Canadian talent.

New legislation in 1936 established the Canadian Broadcasting Corporation (CBC) which continued, until 1958, to be both the provider of the national broadcasting service and the regulatory body for the Canadian broadcasting system as a whole. The two functions were separated by the 1958 Broadcasting Act, which established the Board of Broadcast Governors (BBG) as the regulatory body. The BBG was replaced by the Canadian Radio-Television Commission (CRTC) under the 1968 Broadcasting Act.

The 1968 Act also established (s. 2) a 'Broadcasting Policy for Canada', which is accordingly outside the terms of reference of the Telecommission studies. However, broadcasters are also heavy users of other telecommunications facilities, including land-lines, microwave systems, coaxial cables, and satellite channels. The first coast-to-coast radio broadcast hook-up, in 1928, was made possible by the use of CNT lines. Television programs were at first distributed by air-mail in the form of film recordings, made directly from transmissions at the production point. Simultaneous transmission in separated centres was made possible by microwave links, one of the first having been established between Buffalo and Toronto, and the first Canadian TV network was set up in 1953 between Montreal, Ottawa and Toronto. Today, through the use of microwave and other terrestrial systems, broadcast transmissions can be received simultaneously from coast to coast.

The impact of satellite distribution on Canadian broadcasting has been described[8] as follows:

> "A domestic satellite system of even a few channels would make television service in both French and English, available to any point in Canada. It would do it sooner, and at lower cost, than would any other known system of communication. In particular, it would facilitate the extension of television network service into many areas previously unserved because of the prohibitive cost of a terrestrial microwave feed. (It must be understood that this does not refer to direct broadcasting to the home. It involves reception by special earth stations which will then feed the programmes to local television stations.)"

[8] White Paper—'A Domestic Satellite Communication System for Canada'—28 March 1968.

Discussions are now in progress between CBC and Telesat Canada for the location of the first earth-stations to be associated with the domestic satellite-communications service.

The past decade has seen an explosive development of community-antenna television (CATV) systems, and Canada is now the world's largest exploiter, *per capita,* of this technique. The original purpose of CATV systems was to bring television reception to smaller communities which, for reasons of terrain or distance from transmitters, could not otherwise be served, and it is believed that the earliest Canadian instance was that in Nicolet, Que., where a CATV system was brought into use as early as 1950. However, the Canadian forerunner of urban systems was installed in London, Ont., in 1952, when other advantages of the technique had been recognized. The quality of local transmissions can often be improved by cable distribution, and the public demand for alternative programming—particularly from the United States—may also be satisfied. Today about a quarter of all urban households in Canada are served by CATV systems.

The 1968 Broadcasting Act declared that 'broadcasting receiving undertakings' are part of the Canadian broadcasting system, and CATV systems are accordingly subject to regulation by the CRTC. However, although the equipment now used for local distribution of television by cable is generally suited only to one-way transmission, the addition of two-way amplifiers and switching equipment might permit other services to be offered that are unrelated to broadcasting. In that event, some problems of regulatory jurisdiction could arise; the point is examined in Chapter 19.

CHAPTER 7

Who Provides What

In most countries outside North America, telecommunications services are provided by the state. In Canada, the corporate structure, ownership, and control of telecommunications systems is a very mixed bag, in which it is necessary to take into account not only the telephone and telegraph companies, the broadcasters and the cable-operators, but also the manufacturers of telecommunications equipment. A broader interpretation of telecommunications, which is used throughout this Report, includes data processers, computer utilities, and computer manufacturers. To cover so wide a subject it is necessary to resort to a degree of simplification that will bring into perspective the relationship between corporate structure and the public interest, which is examined in Chapter 17.

Telecommunications Carriers

As a matter of general convenience, the history of telecommunications in Canada has been dealt with under such broad classifications as telegraph, telephone, and radiocommunication. But these are, and always have been, rather artificial distinctions. The word 'telegraph' originally meant a device for transmitting messages of any kind over a distance by any means, whereas the word 'telephone' has always been understood as an electronic device for transmitting voice-messages. Thus, the telephone is, in reality, only one specialized form of telegraph, and indeed the original telephone call made by Alexander Graham Bell in 1876 was carried on wires lent by the Dominion Telegraph Company. When a telephone company offers to transmit any kind of message other than by voice-communication, it becomes also a telegraph company; equally, some telegraph companies provide telephone service in particular areas. Table 1 shows the cost of plant and revenues of the principal Canadian telecommunication carriers.

In 1968[1], 8,818,000 telephones in Canada were served by 2,067 undertakings offering public telephone service. In 1969, the number of telephones had increased to 9,296,000, but the number of telephone undertakings had declined to 1,888. Not all of these responded to the questionnaire sent out by the Dominion Bureau of Statistics, but those that did were classified as shown in Table 2.

[1] DBS Catalogue No. 56-203.

Table 1. Cost of Plant and Revenue, 1969—Principal Canadian Telecommunications Carriers[2]

	($ million)	
	Cost of Plant Before Depreciation	Total Operating Revenue
Bell Canada	3,593.44	842.09***
British Columbia Telephone Company	645.10	152.56
Alberta Government Telephones	476.41	98.85
CN/CP Telecommunications	422.20*	90.87**
Manitoba Telephone System	278.47	52.52
Sask Tel	217.71	47.09
Maritime T&T	172.10	38.39
New Brunswick Telephone Company	159.08	35.33
Québec-Téléphone	112.48	23.93
COTC	111.39	32.22
Newfoundland Telephone Company	55.38	13.26
'edmonton telephones limited'	50.47	18.47
Northern Telephone	19.88	3.94
Island Telephone	16.78	3.59
Ontario Northland Communications	1.51	0.32

[2] Source—DBS Catalogues 56-201 and 56-202.
* CNT—$291.14 million; CPT—$131.06 million.
** CNT—$59.16 million; CPT—$31.71 million.
*** excluding Northern Electric and its subsidiaries.

Table 2. Public Telephone Service in Canada

	Number of Undertakings	Number of Telephones
Federal systems	1	41,763
Provincial systems	9	1,203,708
Municipal Systems	26	297,142
Incorporated companies	92	7,671,580
Co-operatives	1,486	79,450
Sole proprietors	4	2,405
	1,618	9,296,048

Among the smaller incorporated companies, *La compagnie de téléphone des rangs 2 et 3 St. Victor du nord,* for instance, had only 15 telephones: Bell Canada alone, that is to say without its subsidiary companies, had 5,752,820 or 61.9 per cent of all the telephones in Canada.

Among Canadian industrial corporations, Bell Canada is the second largest in terms of total assets[3]. The corporation holds, directly or indirectly, a majority interest in the four telephone companies[4] principally serving the maritime provinces, and in a number of smaller companies[5] operating in Quebec and Ontario. The Bell group of telephone companies, taken as a whole, owns nearly 70 per cent of the telephones in Canada and more than 94 per cent of the telephones east of Manitoba. In the manufacturing sector, Northern Electric Company Limited is a wholly-owned subsidiary of Bell Canada[6]. The Bell group of companies, taken together, has total assets valued at more than $4 billion, gross revenues exceeding $1.25 billion, and some 45,000 employees. Bell Canada has more than 251,000 shareholders; of these, some 97.7 per cent, owning 95.4 per cent of all outstanding shares, are resident in Canada. The largest foreign stockholder is American Telephone & Telegraph (AT&T), with approximately 2.1 per cent of the outstanding shares; a service agreement between the two companies provides Bell Canada with advice and assistance on technical and operating matters for an annual fee[7].

A second important grouping is that under the direct or indirect control of General Telephone & Electronics Corporation (GT&E), which is incorporated and domiciled in New York. This group owns[8] 11.7 per cent of the telephones in Canada through the British Columbia Telephone Company, *Québec-Téléphone,* and their subsidiary companies. In the manufacturing sector, a subsidiary[9] of GT&E is the sole owner of Automatic Electric (Canada) Limited and Sylvania Electric (Canada) Limited, together with their subsidiary companies[10].

In the three prairie provinces, telephone service is provided by provincial Crown corporations—Alberta Government Telephones, the Mani-

3 Source: *Canadian Business Magazine*—'Selected Statistics from Canada's 300 Largest Companies (1969 Edition).

4 Bell Canada holds 99 per cent of the ordinary shares of the Newfoundland Telephone Company Limited, 51 per cent of the issued and outstanding stock of the New Brunswick Telephone Company Limited, and 52.4 per cent of the common shares of Maritime Telegraph and Telephone Company Limited; however, a 1966 amendment to the charter of the last-named company limits the voting power of any shareholder to a maximum of 1,000 shares. Maritime Telegraph and Telephone Company Limited owns 56 per cent of the common shares of The Island Telephone Company.

5 See Telecommission Study 1(b) for details.

6 See Page 75 for further details of this relationship.

7 See Chapter 17 for details.

8 Anglo-Canadian Telephone Company, a subsidiary of GT&E incorporated in Quebec, owns 51.31 per cent of the outstanding ordinary shares of BC Telephone and a controlling interest in *Québec-Téléphone.*

9 General Telephone & Electronics International Incorporated.

10 See Page 75 for further details of this relationship.

toba Telephone System, and Saskatchewan Telecommunications. Together, they own some 12.8 per cent of the telephones in Canada. The two largest municipal systems are those in the cities of Edmonton and Thunder Bay; other municipal systems are relatively small.

Before the formation of the Trans-Canada Telephone System (TCTS) in 1931, Canada had to rely on transmission through the United States for most of its trans-Canada telephone routings. TCTS is a voluntary association of eight large telephone undertakings (which, with their subsidiaries, own 96 per cent of the telephones in Canada) working together to provide a complete communications network from coast to coast. The members of TCTS are[11]:

Alberta Government Telephones*
Bell Canada**
British Columbia Telephone Company
Manitoba Telephone System*
Maritime Telegraph and Telephone Company Limited**
The New Brunswick Telephone Company Limited**
Newfoundland Telephone Company Limited**
Saskatchewan Telecommunications*

The TCTS, although it is not incorporated, has a Board of Management, comprising Directors representing all member companies, which meets frequently; all decisions are based on unanimous agreement. The Board is supported by operational and administrative committees which plan and coordinate nation-wide services and facilities, including the establishment of design standards and common operating procedures. TCTS arranges for the division of System revenues among its members[12], and they in turn arrange settlements with most of the independent companies. The intention is to ensure that these settlements, which are arrived at through a bargaining process, result in a fair share of revenues derived from the provision of a national service.

The Telephone Association of Canada (TAC) was formed in 1921 to promote the exchange of technical and operating information. Its membership includes the eight participants in TCTS and:

'edmonton telephones limited'[13]
The Island Telephone Company Limited**
Northern Telephone Limited**

[11] Canadian Overseas Telecommunications Corporation is an associate member.
* A provincial Crown corporation.
** Bell group.
[12] For further details, see Chapter 19.
[13] 'edmonton telephones limited', like the poet e.e. cummings, has opted for a lower-case corporate designation.

Ontario Northland Communications*
Québec-Téléphone.

Thus, of the 13 companies comprising the membership of TAC, eight are shareholder-owned companies, of which six belong to the Bell group and two are indirectly controlled by a foreign corporation; four are provincial Crown corporations; and one is a municipal system.

There are several other associations that represent the interests of the 'independent' telephone companies, all with objects basically similar to those of TAC. Some examples are the Canadian Independent Telephone Association, the Quebec Independent Telephone Association, the Ontario Telephone Association, and the Saskatchewan Association of Rural Telephone Companies.

The telegraph sector of the industry is dominated by CN/CP Telecommunications, a consortium of the telecommunications departments of Canadian National Railways and Canadian Pacific. A small number of independent railroads[14] provide, within limited areas, public message-telegraph service (and, in some cases, telephone service), but their primary concern is the provision of communications for their own operations. CN/CPT, however, operates as a nation-wide telecommunications carrier, offering private-line services as well as public message-telegraph service. CNT also offers public telephone service in certain areas of Newfoundland and the Yukon and Northwest Territories.

The two components of CN/CPT are integral parts of their respective rail organizations, but charges for service provided to and received from other departments of the parent companies and company subsidiaries are assessed at commercial tariffs. Each has access to a number of corporate services for which they are billed according to use made, and each competes with other departments within its own corporate structure for capital allotments. The financial principle underlying the consortium is that (except for services provided by only one company) there should be equal contributions in terms of capital investment and operating costs, in return for which all revenues would be shared equally.

The Canadian Overseas Telecommunications Corporation (COTC) was incorporated by federal statute in 1949. The principal purposes of this Crown corporation are:

— to establish, maintain and operate in Canada and elsewhere external telecommunications services for the conduct of public communications;

* A division of the Ontario Northland Transportation Commission, a provincial Crown corporation.

14 Quebec North Shore and Labrador;
Algoma Central;
Northern Alberta (jointly owned by CNR and CPR);
Ontario Northland;
Pacific Great Eastern.

— to carry on the business of public communications by cable, radiotelegraph, radiotelephone or any other means of telecommunication between Canada and any other place.

COTC operations have been concerned, in practice, with overseas communications, excluding direct service to places in, or more conveniently reached through, the United States[15]. Through international-gateway switching-centres in Montreal and Vancouver, public telephone service is provided by COTC to some 200 overseas territories. Public message-telegraph service is made available, directly or indirectly, by COTC and two foreign corporations—Western Union International Inc., and the Commercial Cable Company (a subsidiary of ITT World Communications Inc.), both of which have retained terminal rights in Canada granted before 1949. COTC is also the 'designated operating entity' for Canadian participation in INTELSAT[16].

Unlike COTC, Telesat Canada, incorporated by federal statute in 1969, is—by statutory declaration—"not an agent of Her Majesty or a Crown Corporation". Its principal object is "to establish satellite telecommunication systems providing, on a commercial basis, telecommunication services between locations in Canada". Provision is made for shares to be held, in proportions to be determined by the Board of Directors with the approval of the Governor in Council, by "Her Majesty in right of Canada; approved telecommunications common carriers; and persons who fulfill the statutory conditions", the two latter classes of shareholders being defined in Schedules annexed to the Act[17]. In brief, the "statutory conditions" provide for the holding of shares, up to specified limits, by "Her Majesty in right of any province" and by the general public (while disqualifying certain persons associated with "approved telecommunications common carriers" and also foreign governments or their agents). The authorized capital of the corporattion is limited to 10 million common shares, without nominal or par value, and 5 million preferred shares with a nominal or par value of $10 a share; the shares may be issued "at such times, and for such consideration" as the Board of Directors may determine with the approval of the Governor in Council.

The initial capitalization of Telesat Canada took place in December, 1970. The Government and the telecommunications carriers subscribed for two million common shares issued at $10 a share, and a person fulfilling the statutory conditions (the President of the corporation) subscribed for one share at $10. The Government and the carriers will subscribe for the remain-

15 For details of international operations, see Chapter 8 and Telecommission Study 3(e).

16 See Chapter 8.

17 The 13 "approved telecommunications common carriers" are, at present, the eight members of TCTS together with The Island Telephone Company Limited, *Québec-Téléphone*, Ontario Northland Communications, and the Canadian National and Canadian Pacific Railway Companies.

ing two thirds of their subscriptions at intervals from time to time until early 1972, to provide Telesat with a total of $60 million. The remaining $30 million required by the corporation before commercial operations begin will probably be met by an interim Government loan if a public offering has not by then been made. An offering to the public may not take place until the satellite system becomes operational.

The general management of the affairs of Telesat Canada is vested in the Board of Directors, at present consisting of five members appointed by the Governor-in-Council, five members elected by the telecommunications carriers, and one member elected by a person fulfilling the statutory conditions (the President of the Corporation). Once a public issue of shares has been made, the representation of the public will be appropriately increased.

Broadcasting

The corporate structure of the Canadian broadcasting industry is exceedingly complex, and can be given no more than a passing reference here. The Broadcasting Act declares that "broadcasting undertakings in Canada .... constitute a single system, ... comprising public and private elements". The public element is the national broadcasting service provided by the Canadian Broadcasting Corporation (CBC). Table 3 gives an indication of the relationship between the Corporation and the private element of the system in terms of broadcasting transmitting stations (including re-broadcasting and low-power stations, figures for which are shown in brackets).

Table 3. Canadian Broadcasting Stations[18]

National Networks	Television	AM Radio	FM Radio	Short-wave Radio
CBC	114 (66)*	266 (231)	10	16**
CBC Affiliated Private Stations	199 (151)	97 (1)	22 (5)	—
Total—National Networks	313 (217)	363 (232)	32 (5)	16
Private Sector				
CTV Network	48 (32)	—	—	—
Unaffiliated	12 (7)	186	54	6
CBC Affiliates (as above)	199 (151)	97 (1)	22 (5)	—
Total Private Sector	259 (190)	283 (1)	76 (5)	6
Public Sector (CBC)	114 (66)	266 (231)	10	16**
GRAND TOTAL	373 (256)	549 (232)	86 (5)	22

[18] Source: CRTC, December 1970.
* Excluding a UHF educational station in Toronto.
** This figure does not, strictly speaking, apply to 'radio stations', but the CBC has 16 assigned frequencies in the shortwave broadcasting bands.

In addition to these broadcasting transmitting stations, by April 1970 licences had been issued to 251 companies[19] operating 305 CATV systems serving more than a million subscribers in 443 locations, or about 40 per cent of the households in the areas served. The number of subscribers to an individual CATV system ranges from about 100 to over 100,000.

The Canadian broadcasting industry today is in a state of flux, partly due to the stipulations imposed by the Government with regard to Canadian ownership so as to fulfil the requirement in the Broadcasting Act that "the Canadian broadcasting system should be effectively owned and controlled by Canadians". The impact is perhaps most severely felt in the CATV sector, for by 1967 United States companies owned or controlled CATV undertakings which accounted for 77 per cent of all Canadian subscribers. The requisite changes of ownership are proceeding under the close supervision of the CRTC.

The CRTC is also engaged in the examination of multiple ownership of broadcasting undertakings and other mass media, having particular regard to the requirement in Section 2(d) of the Broadcasting Act that "the programming provided by the Canadian broadcasting system should . . . provide reasonable, balanced opportunity for the expression of differing views on matters of public concern". The particulars published by the Commission offer an interesting exercise for jigsaw-puzzle fans or genealogists, for the web of interlocking interests and directorships is far more intricate than the family tree of the Spanish Hapsburgs, who seldom married outside the family. No adequate explication is possible in this context, but the complexities may perhaps be dimly perceived when it is seen that five of the more important ownership groups (each a tangled web of corporate relationships) together own, control, or have an interest in 59 television stations, 47 radio broadcasting stations, 28 CATV systems, and 17 daily newspapers.

Ownership links between broadcasting undertakings and other sectors of the telecommunications industry, if any exist, are hard to discern. The Bell Charter prohibits Bell Canada and its subsidiaries from holding broadcasting licences (including licences for CATV systems). Further, on 3 December 1969 the CRTC announced its conclusion "that it would not be in the public interest to encourage common carriers to hold licences for CATV systems".

Manufacture of Telecommunications Equipment

To identify the telecommunications manufacturing industry, it is necessary to establish some rather arbitrary limits. This discussion accordingly

[19] Source: CRTC.

deals only with manufacturers of equipment directly employed in telecommunication, including broadcasting and data-processing. Although some of the larger manufacturers make most of their own components, the telecommunications sector of the industry has not been deemed to include manufacturers of basic electronic and electrical components or equipment of more general applicability.

The Canadian market for telephone, telegraph, and switching equipment is supplied primarily by two large manufacturing organizations[20] which have corporate links with telecommunications carriers. Northern Electric, which has a number of subsidiaries[21], is a wholly-owned subsidiary of Bell Canada; the research and development facilities of both companies now operate independently under a newly formed subsidiary corporation. The GT&E group, which indirectly controls BC Telephone and *Québec-Téléphone,* also includes Automatic Electric (Canada) (of which Lenkurt Electric is a subsidiary), Sylvania Electric (Canada) and its subsidiaries[22] and Canadian Telephones and Supplies Limited (offering installation and repair services). Both groups have agreements with associated organizations in the United States, providing for exchanges of technical information and the results of research. However, the Bell/Northern Electric complex does much of its own research, development, and product design, and represents not only the largest but the only distinctively Canadian element of the telecommunications manufacturing industry in Canada; the Bell group accounts for exports of electronic equipment valued at $100 million in 1970.

In addition to the two carrier-linked manufacturing organizations and a variety of small specialist companies, there are about a dozen substantial manufacturing undertakings. Most of the latter are subsidiaries or affiliates of companies with much wider interests, which in turn are linked with foreign companies, mostly in the United States. To a large degree, the Canadian production of foreign-owned firms is dictated by the corporate decisions of the parent organizations. The Department of Industry, Trade and Commerce has tried, with some success in a few cases, to influence multi-national companies to assign to their Canadian subsidiaries the responsibility for design, development, and international marketing of complete product lines. Northern Electric and some of the smaller specialty companies are Canadian-owned, and the former is the only Canadian example of a complete manufacturing capability.

20 Ancom Systems, equally owned by Northern Electric and Automatic Electric (Canada), has recently been incorporated for the marketing, design, and installation of satellite earth-stations.

21 Dominion Sound Equipment Limited; Microsystems International Limited; Northern Electric Caribbean Limited; Northern Electric Hellas; and Northern Electric Telekomunikasyen A.S. Turkey.

22 Electrolier Corporation; W. Freeman and Son; and Powerlite Service.

Data Processing

The data-processing industry is amorphous and volatile. The situation in Canada is not unlike that in the United States, where more than half the companies incorporated in the last 20 years are no longer in existence. It is difficult, if not impossible, to be precise about the corporate structure of the industry for two reasons; first, there is an almost continuous process of take-overs and acquisitions of controlling interests, so that what may be true today may no longer be true tomorrow, and second, many of the firms in the industry are private companies, for which little information is available.

At the time of writing, 286 organizations had been listed, and the total is probably well over 300 for the whole of Canada. Adequate information about corporate structure is readily available for only 54 of these companies. One is a subsidiary of a British organization, and 20 are controlled directly or indirectly from the United States. Two Canadian telecommunications carriers are involved; CNT and CPT jointly hold a controlling interest in Computer Sciences (Canada) Limited (49 per cent of the equity being held by Computer Sciences Corporation in the United States), while *Québec-Téléphone* (which is indirectly controlled by GT&E in the United States) also offers data-processing services. Computer Sharing (Canada) Limited is controlled by Polymer, a federal Crown corporation, but about 20 per cent of the common shares are held by Com-Share Inc., a United States corporation. The remaining 30 principal companies offering remote-access time-sharing services are incorporated in Canada, but this mere fact affords no evidence that they are necessarily under Canadian ownership and control; it may well be that more than half of them are not. The largest single time-sharing data-processer in Canada today is Canadian General Electric, while significant parts of the time-sharing market are also exploited by IBM Canada and Control Data (Canada); all three are controlled directly or indirectly from the United States. While Canadian firms have acquired up to 40 per cent of the time-sharing market, about 80 per cent of the total commercial data-processing market in Canada is held by the principal foreign-controlled computer manufacturers, among whom IBM has by far the largest share.

Computer Manufacture

The manufacture of electronic computers and related equipment in Canada has been concentrated mainly on peripheral equipment not generally available from foreign sources, for which a substantial export market has been established, principally in the United States. Eight of the ten largest Canadian computer equipment manufacturers are subject to foreign control, and the largest—IBM Canada—is responsible for about 70 per cent of the

total activity[23]. Much of the output of this company is destined for inter-company sales throughout the world; Canadian production tends to be concentrated on a limited number of equipment-lines, which will be expanded to include a monolithic memory component, according to an announcement in 1969. Another manufacturer, Control Data (Canada), has recently announced its intention to produce computer central-processing units in Canada for sale in world markets.

Summary

By way of summing up an account that is itself a highly condensed summary, a few important features of the corporate structure of the Canadian telecommunications industry can be singled out. Bell Canada is pre-eminent among the carriers, and is Canadian owned; only two of the other large carriers are subject to foreign control, and five are federal or provincial Crown corporations. In the broadcasting sector, if re-broadcasting and low-power stations are left out of account, the CBC owns and operates 30 per cent of the television stations and 44 per cent of the radio broadcasting stations in Canada, while another 53 per cent of the television stations and 18 per cent of the radio broadcasting stations, all in private ownership, are affiliated to the CBC national networks; the private segment is subject to strict requirements as regards Canadian ownership. Northern Electric, a subsidiary of Bell Canada, is predominant in the telecommunications equipment manufacturing sector, in which most of the other large firms are under foreign control. By far the largest share of the Canadian data-processing market accrues to Canadian General Electric and IBM Canada, both subsidiaries of multi-national organizations controlled in the United States. IBM is also by far the largest Canadian manufacturer of computer equipment. The implications of corporate structure and foreign ownership in the Canadian telecommunications industry are discussed, in relation to the public interest, in Chapter 17.

23 The IBM share of the Canadian computer market is said ("Computers and Automation", October 1970) to be larger than of any other national market.

CHAPTER 8

For Whom the Bell Tolls

In describing telecommunications services, a distinction can be drawn between public services—telephone, telegraph, broadcasting—and private communications systems. The distinction is one of convenience only, and no hard and fast limits can be drawn; for the companies providing public telephone and message-telegraph service also offer private-line facilities for the transmission and distribution of broadcasting service.

Everybody is familiar with the ordinary features of the public telephone service, which enables Canadians in all but a few remote parts of the country to dial direct almost anywhere in Canada or the United States, and to connect otherwise with any telephone in most parts of the world. But there are wide disparities between regions in the number of telephones per 100 population, which ranges from 24.6 in Newfoundland to 48.5 in Ontario, and averages 43.7 for the whole of Canada. With more than nine million telephones, Canadians are among the most talkative people in the world, indulging in over 15 billion conversations in 1969, but there are still thousands of their compatriots who have no access to any telecommunications services at all.

The larger telephone companies also offer a number of special voice-communication services connecting with the public switched network. Private Branch Exchange services use a centralized switching system controlled from the customer's premises, either manually (PBX) or automatically (PABX), to provide internal communications connecting with the public exchange service. Conference-call services are provided through the public telephone exchange network (and, for certain subscribers, by CN/CPT). Data-phone service, offered by TCTS, permits the use of the switched telephone network for transmission of data from punched cards or tape, or magnetic tape, between two or more terminals or computers.

Touch-Tone telephone instruments can be used as simple data-input terminals, providing the possibility of low-cost data-transmission service through the switched telephone network. They may be regarded as the harbingers of new services that will be made available to telephone subscribers in the relatively near future, some of which are already being operated on an experimental basis in limited areas.

Wide-Area Telephone Service (WATS), a package-rate deal for one-way service, comes in two forms—OUTWATS, which enables a subscriber to make

only outgoing calls to specified WATS zones in Canada, and INWATS, by which customer-dialed calls from specified WATS zones can be received without charge to the originating caller; service is either Full-Time, giving unlimited communication within specified WATS zones at a monthly rate, or Measured-Time, which combines a period rate with an additional hourly rate. Zenith service permits subscribers in one exchange area to be called directly from another area without expense to the caller.

Public commercial mobile-telephone service, the demand for which is increasing rapidly, provides connections between the ordinary public exchange system and mobile units (cars, boats, airplanes, and even—for special customers—satellites, or the moon itself), or between two mobile units, through one or more radio repeaters. Radio transmission is also used for paging and other mobile services.

Various private-line services, dedicated to special uses, serve a wide range of other requirements. "Hot-Line" service gives instantaneous connection without dialing between two telephones not connected to the public exchange system; one of the largest private networks of this kind, involving some 55,000 miles of circuitry, is used for air traffic control in Canada, with connections to a similar network in the United States. Telpak A, B, and C is a private-line voice service offered by TCTS in groups of 12, 24 and 60 voice-grade circuits respectively. Telpak S, available only in southern Ontario and Quebec, provides 120 voice-grade circuits. CN/CPT offers similar facilities on a special-assembly basis.

Public message-telegraph service, once the principal business of the telegraph companies, now accounts for only some 15 per cent of total CN/CPT revenues[1]. Messages may be filed over the counter, by telephone, or by Telex (see below), and are transmitted by teleprinter and facsimile equipment through the automated telegraph networks. Messages are now generally delivered by telephone, with confirmation through the mail if requested.

Both private-line and switched teleprinter services are available; the latter are regarded by some regulatory bodies as public services and by others as private-line services. Telex (CN/CPT) and TWX (TCTS) are switched teleprinter services providing connections only with other subscribers to the same system in Canada and the United States. The two systems are incompatible, and interconnections are not at present available in Canada, but overseas connections to both systems are provided through COTC conversion facilities[2]. Data-Telex is similar to Telex but faster; terminal compatibility is not required by CN/CPT, and interconnection between all Data-Telex subscribers therefore cannot be guaranteed.

[1] See Chapter 16.

[2] Blocking arrangements exist to prevent Canadian Telex or TWX subscribers from reaching overseas points through the United States networks.

The telecommunications carriers also offer a variety of non-standard services specially designed and assembled to meet specific customer requirements, which may or may not entail interconnection with the switched networks. Datacom (TCTS) can communicate with other similar terminals or with a computer. In 1968, TCTS instituted Data-line service connecting customers with time-sharing computers, and has recently introduced a broadband switched network (Multicom) for data transmission, which features very high transmission speeds up to 60,000 words a minute. The service may be used for transmitting data directly from computer to computer, or for sending batches of data for processing on remote computers; data may be sent and received simultaneously, and a voice channel can be provided.

In 1967, CN/CPT introduced Broadband Exchange Service, employing an automatic switching system especially designed for simultaneous two-way data transmission. The system has the capability, on customer demand, of transmitting computer data at 51,000 words a minute; voice-quality facilities are used, so that telephone service featuring abbreviated dialing, "Hot Line", and conferencing is available to subscribers to this service (although not offered as a public service). International "Hot Line" services offered by CN/CPT are at present available only between Montreal and New York and Toronto and New York.

Private-wire teletype systems may be rented from the telecommunications carriers. Examples include the extensive weather-reporting and air-operating networks, and the distribution of stock-market quotations; ticker-tape service from the Toronto Stock Exchange has been available since 1909. However, many companies requiring these services are now changing over to the new computer-controlled switching systems, which can convert transmission codes and speeds, and control the flow of message traffic, through store-and-forward switching techniques.

Broadcasters are heavy users of private-line transmission services, using specially designed high-quality facilities for the network transmission of radio and television programs. Community-antenna systems distributing television and FM radio to paying subscribers employ cable connections which are often leased from the local telephone companies; in some cases, microwave systems are used for transmission from distant head-ends.

Other communictions services of various kinds are owned and operated by the users; examples are the microwave systems of some hydro and other utility undertakings, and the radiocommunications employed for air and marine traffic control, and by the police, the fire and forestry services, and taxi companies.

The availability of some of the more sophisticated services that have been described is limited by regional disparities in the capacity of existing telecommunications plant and equipment in Canada. While Touch-tone

instruments and high-speed data services are available in some areas, many central offices elsewhere are still equipped with slow rotary switches dating back to the 20's, which are unsuitable for Touch-tone signalling or making data connections. In some regions virtually all the switching plant is of this obsolescent type, and it has been estimated that investments equal to perhaps one-third of the total present assets of the carriers would be necessary to bring all this plant up to contemporary technical standards.

International Services

The development of Canadian facilities for international telecommunications traffic has been influenced both by geography and history. As part of the great land-mass of North America, Canada has developed north-south services closely integrated with those of the United States. As a member of the Commonwealth, Canada enjoys a strategic central position in a vast telecommunications network extending from Britain to Australia and South-east Asia. For convenience, the former system will be referred to here as 'continental', and the latter as 'overseas', even though numerous exceptions deprive these words of their strict dictionary meaning.

The 'continental' system covers services between Canada and the United States (including Alaska, Hawaii, and certain overseas possessions such as Puerto Rico) and Mexico. In the 'continental' system, except for Alaska, public telephone service is effected through automated facilities of the Trans-Canada Telephone System (TCTS); numerous border crossings are provided by the six member companies operating in provinces that have land borders with the United States. Rates are based on the airline distance between designated rate-centres, and fall between the domestic rates established by TCTS and those of American Telephone and Telegraph (AT&T). Traffic interchanged with Mexico is charged at the rate between the Canadian point and the United States/Mexico border crossing, to which the Mexican domestic rate is added. Connections with Alaska are effected through gateways provided by the British Columbia Telephone Company, Alberta Government Telephones, and Canadian National Telecommunications (CNT); rates are based on zones instead of on distance between rate-centres. All these arrangements in the 'continental' system apply generally to other services provided by the telephone companies, and rates are the same in both directions.

Public message-telegraph service in the 'continental' system is exchanged, except for Alaska, between CN/CPT and Western Union through facilities, owned by the latter, in Minneapolis. Rates are set through negotiation and agreement between the parties providing the service, but require prior approval of the Canadian Transport Commission (CTC) and of the Federal Communications Commission (FCC) in the United States;

the approval of CTC is also required for rates for other continental services offered by CN/CPT. Service to Alaska is provided by CNT alone by interchange with the Alaska Communications System; rates are the sum of the two domestic rates.

In the 'overseas' telecommunications system, public telephone service to about 200 overseas territories[3] is provided by the Canadian Overseas Telecommunication Corporation (COTC) through international gateway switching-centres in Montreal and Vancouver. Beyond these points, telephone traffic is carried for the most part by submarine cables and satellite circuits; a few HF radio circuits are still in operation, but will be phased out during the next few years.

Canada took an active part in early discussions aimed at the development of telegraph cable connections between Britain and British possessions west of the Pacific Ocean without passing through foreign territories, and from 1899 participated financially in their establishment during the ensuing 50 years under successive managerial bodies. The Commonwealth Telecommunications Board, established in 1949, was the predecessor of the Commonwealth Telecommunications Organization (CTO) set up in 1968[4], in which Canada is a participant.

The rapid growth of overseas telephone traffic during the last 20 years has been facilitated by Canadian participation through COTC in a complex of submarine telephone cables crossing the Atlantic and Pacific Oceans. The Commonwealth Cable Management Committee, on which the President of COTC represents Canada, functions outside the CTO and is responsible for the operation of these telephone cables. The possibility of more effective liaison between the two bodies, with a view to eventual amalgamation, is being examined. The total Canadian investment in the Commonwealth telecommunications systems amounts to about $55 million.

Satellite circuits used by COTC are provided through the facilities of the International Telecommunications Satellite Consortium (INTELSAT), which was established in 1964 by international agreement on 'Interim Arrangements' for a global commercial communication-satellite system. At the time of writing the membership of INTELSAT included 77 countries. Canada was a party to the original agreement, and has designated COTC as a member of the Interim Communications Satellite Committee (ICSC), to participate in the design, development, establishment, maintenance and operation of the space segment of the system. All signatories are entitled to invest in and utilize the system, the level of investment being proportional to anticipated usage. Total expenditures and commitments on the space segment amount to an estimated $400 million (US), of which the Canadian

[3] Service to some 35 other countries is routed, for practical reasons, through international gateways in the United States; for details see Telecommission Study Report 3(e), Appendix D.
[4] For details, see Telecommission Study 3(a).

share will be about $14 million (US). Participating communications entities are responsible for the construction and operation of earth-stations; COTC accordingly operates the earth-stations at Mill Village, N.S., and planning is now in an advanced stage for another at Lake Cowichan, B.C., to be operational in 1972.

The Communications Satellite Corporation (COMSAT) acts as the agent of INTELSAT for the management of the space segment of the system, and also represents the United States on the ICSC. Negotiations are now under way for the replacement of the 'Interim Arrangements' by 'Definitive Arrangements' for the continuation of INTELSAT. Canadian objectives in these negotiations are to clarify the role of the organization and the services that it may provide, to improve its structure as an international organization, and to broaden international participation without sacrificing efficiency. More specifically, Canada would be in favour of allowing INTELSAT to provide, on request by a Member, some domestic, regional, and special services, insofar as this can be done without detriment to the prime objective, which is to provide efficient public international services. Canada also takes the position that an Assembly of representatives of member governments[5] should have a voice in general policy and the long-term program of the organization, and that the management function should be transferred, gradually but within a specified time, from COMSAT to an international management group.

In the past decade, satellite communications have been very effective in bringing improved services to many countries formerly dependent on poor-quality radiocommunications, but there have also been striking improvements in submarine-cable technology. The first of the modern telephone-type cables, installed from 1956 on, carried some 40 to 120 circuits and used vacuum-tube amplifiers located at 30-mile intervals. Newer designs now becoming available will carry 2,000 to 3,000 circuits and will have transistor amplifiers at distances of five to seven miles throughout the length of the cable.

It is impossible to predict, with any degree of certainty, whether satellite or cable systems will predominate on many of the overseas routes as they are developed during the next two decades. It is even difficult to promote the selection of one facility rather than the other, because cost is not the only factor that enters into such decisions. Telecommunications planners usually strive for variety in the types of facilities to be deployed, so that system-strength and continuity of service may be ensured through diversity. Relative costs obviously cannot be ignored but, within limits, some extra cost can be justified if it helps to achieve the ideal total system.

[5] As distinct from the operating entities designated by governments, e.g. COTC by Canada.

It seems probable that cable and satellite development will continue in parallel on medium-distance routes, of which the North Atlantic is an example. The demand on this important route is expected to rise from 2,000 circuits at present to some 30,000 in 1985, of which 4,500 would be required by Canada. Some experts argue that traffic on such a route should be split equally between cable and satellite circuits—a balance that would be realizable, in any event, only for a relatively short time. It is difficult to be at all precise about developments in the longer term, for continuing improvements will certainly be made in both modes of transmission and will have a bearing on their relative use, while competition between their respective proponents is likely to be an important factor.

On shorter routes, Canada/Bermuda for example, cables will surely continue in use; but satellites offer flexibility, particularly for television transmission, even on these short routes, and will probably also be in demand. On the trans-Pacific and other longer routes, where cables now exist, additional installations may be difficult to justify to any great extent owing to their substantially higher cost than satellite systems, which will probably take the lead over cable as the means to provide for future expansion.

In the 'overseas system', public message-telegraph service is provided by COTC through a message-switching centre in Montreal and thence over the cable and satellite facilities described above. Two foreign international carriers have retained terminal rights in Canada which were originally granted before COTC was incorporated in 1949. The Commercial Cable Company (CCC), a subsidiary of ITT World Communications Inc., leases trans-Atlantic circuits from COTC, with extensions to Montreal and Toronto leased from the domestic carriers; terminal operations are handled for CCC by CPT in Montreal and by CNT in Toronto. Western Union International (WUI) in addition to leasing circuits from COTC for Canadian overseas telegraph traffic, is licensed under the Telegraphs Act to operate a submarine cable between Canada and the Azores, where connections are made to reach Europe. Additionally, two parallel cables between Bay Roberts, Newfoundland, and Hammil, N.Y., are licensed for through service, by which traffic destined for or originated in the United States may be exchanged by way of the Azores cable or with circuits leased by WUI[6]. COTC and WUI each have a telegraph office in Montreal for the convenience of local customers; otherwise, all overseas telegraph service is originated and terminated through CN/CPT.

The Eastern Telephone and Telegraph Company, a Canadian subsidiary of AT&T, has no terminal rights in Canada but is licensed under the Telegraphs Act to operate certain external trans-Atlantic cables carrying

[6] Although WUI licences remain valid, these cables are not at present in use.

through traffic between the United States and Europe. For this purpose, the company is licensed under the Radio Act (jointly with COTC) to operate a chain of microwave stations between the cablehead at Sydney Mines, N.S., and Spruce Lake, N.B. (where Montreal traffic is diverted through COTC facilities), and onward to the United States through a station, licensed to Eastern alone, at St. George, N.B.

Rates for 'overseas' telecommunications services are generally determined through bilateral agreements between COTC and other international carriers, taking into account the requirements of governments and operating companies in the countries in which services terminate or through which they pass in transit. In general, rates match those used by United States carriers for similar services, and are based on a world-wide plan, originally agreed between AT&T and the British General Post Office, which is now in effect in most parts of the world. The schedule of rates is based on the airline mileage between the centres of geodesically defined zones, but there is some flexibility to allow for the geographical incidence of large centres of population, and also for exceptional community of interests between particular countries. COTC does not share in the revenue derived from telephone traffic to overseas points served through international gateways in the United States[7]; the rates for this traffic are established by agreement between TCTS and AT&T.

In general, it can be said that international telecommunications services available in Canada are of a relatively high standard and among the cheapest in the world. It must be recognized, of course, that the standard of service is not entirely within the control of the Canadian carriers. In the 'continental' system services are integrated and operated, except in remote or rural areas, to common North American standards. Conditions are often quite different in the 'overseas' system, where improvement in the service between Canada and some other countries must depend on the introduction by the latter of modern operating methods and procedures, and of compatible numbering plans, routing methods, and signalling schemes.

Within the 'continental' system, Canada is in the extraordinary position, for a sovereign state, of being dependent for essential international services on agreements and arrangements made by TCTS—a consortium of shareholder-owned companies and provincial Crown corporations. Where, in some cases, matters are referred to the regulatory authority (CTC) for approval or information, there is no provision for consultation with the Department of Communications or with COTC—a federal Crown corporation which has a statutory responsibility "to co-ordinate Canada's external telecommunication services with the telecommunication services of other nations". It is also believed that, as a result of inter-carrier agreements in certain cases, traffic

[7] See footnote 3.

that could be handled by COTC is being routed through United States carriers. Recently, for example, a private-line circuit between Canada and Cuba was established by Western Union International without any prior reference to or consultation with COTC or the Department of Communications.

It must be recognized, of course, that international services available in Canada are subject to agreements between operating entities and, in some cases, to approval by foreign regulatory bodies. Nonetheless, it would appear desirable to give further consideration to the feasibility of establishing some form of supervision, on behalf of Canada, over proposed policies, service arrangements, and rate structures within the 'continental' system, and over services between Canada and countries that cannot be directly reached through COTC facilities.

CHAPTER 9

A Girdle Round About the Earth

Beyond the operation and use of international telecommunications channels throughout the world, Canada is committed to the principle of promoting world community through communications. Thus, while the establishment of effective world telecommunications links has been a primary objective, Canadian concern has been carried further, towards the promotion of international cooperation and understanding in and through communications. Canada has participated actively in all important discussions in international forums, and has worked towards solutions of communications problems that would serve both to allay fears of the potentially disruptive effects of new communications techniques and services, and yet to sustain technological impetus and economic progress.

A belief that communications can, despite the inherent dangers, ultimately draw men closer to each other, and towards a sense of global community, has been fundamental to Canadian international telecommunications policy. The Minister of Communications is charged by law to "take such action as may be necessary to secure, by international regulation or otherwise, the rights of Canada in communications matters"[1], and co-operates for this purpose with the Secretary of State for External Affairs through the active collaboration of their respective departments. A prime Canadian objective has been to promote the establishment and growth of international facilities accessible to all nations, so that communications can be effected between all people, anywhere in the world, and thus lead to better understanding, cultural enrichment, and improved living standards.

In 1907, Canada became a member of the International Telegraph Union, which had been founded in 1865. Today, re-named the International Telecommunications Union (ITU), this is the oldest organization in the United Nations family of specialized agencies, with 139 member countries; its headquarters are in Geneva. The principal functions of the ITU are to allocate bands in the radio-frequency spectrum to particular telecommunications services, and to co-ordinate national uses of radio frequencies so that they remain free from mutually harmful interference. Other objectives are to maintain and extend international co-operation for the improvement and rational use of telecommunications of all kinds, and to promote the de-

[1] Government Organization Act, 1969, Section 10(1)(f).

velopment of technical facilities and services, their most efficient operation, and their general availability to the public.

The constitutive Convention of the ITU is supplemented by Radio, Telegraph and Telephone Regulations. Canada is a signatory to all but the last, although a forthcoming draft revision of the Telephone Regulations may prove less restrictive and therefore more acceptable to the telephone industry and the Government.

With the advent of satellite communications, it has become necessary for the ITU to take positive action with regard to this new technology and the improved services it can provide. At the forthcoming World Administrative Radio Conference in the summer of 1971, additional allocations in the spectrum to accommodate the various space services will be made. Canada is submitting several amendments to the Radio Regulations which will be taken up at the Conference. These amendments are directed towards guaranteeing a clear and unequivocal international right to protection from harmful interference for users in states that adhere to ITU rules and regulations. The Canadian delegation to the Conference, following an objective set forth in the recent White Paper entitled "Foreign Policy for Canadians", will seek to "obtain an equitable use of the radio-frequency spectrum for all space communications and an adequately-planned means of ensuring the fair sharing of synchronous orbit positions."

Canada has also been taking a careful look at the structure and procedures of the ITU, which has four permanent organs. The International Frequency Registration Board (IFRB) records and circulates frequency assignments made by member countries, carries out technical examinations of frequencies, and provides advice on spectrum usage and interference problems. The International Radio Consultative Committee (CCIR) studies and makes recommendations on technical and operating methods relating specifically to radiocommunications. The International Telegraph and Telephone Consultative Committee (CCITT) studies and makes recommendations on technical, operating, and tariff questions relating to telegraphy, telephony, and—more recently—data transmission. The General Secretariat is the fourth organ of the ITU.

Canada and some other countries believe that there are inherent weaknesses in so decentralized a structure, in terms of co-ordination and efficiency, while procedures for arriving at decisions within the organization might also be somewhat more streamlined than at present. The Canadian position with regard to enforcement is that there might advantageously be more 'teeth' in ITU procedures, so that the very useful standards and rules of conduct set forth in the Convention and the Regulations may be more effectively applied. Finally, the procedures for settlement of disputes might be made more compelling, so that differences could be expeditiously and

authoritatively resolved. These and other suggestions were made, in particular, at a Conference on International Communications, held in Ottawa in October 1969, under the auspices of the Department of Communications and the Canadian Branch of the International Law Association.

It is becoming even more important to strengthen the ITU in response to the impact of satellite technology on telecommunications. New services, the development of radio on earth and in space, and increasing demands being placed on the radio-frequency spectrum, all give rise to the need for a stronger and more responsive international body. The next opportunity to effect necessary changes will be at the ITU Plenipotentiary Conference scheduled for 1973. In preparation for this, a working group has been set up within the Government to review the present ITU Convention in depth, and to elaborate proposals for its improvement.

Representatives of the Canadian telecommunications industry have expressed the wish to be more fully consulted in advance on matters to be resolved at ITU Conferences, and have recommended the establishment of regular consultative machinery for this purpose in place of the *ad hoc* arrangements made in the past. The Canadian National Organization for CCIR (CNO/CCIR), which might serve as a model, is composed of study groups, subdivided into working parties, along the same lines as the CCIR itself. The working parties comprise representatives of government departments and agencies, the manufacturing industry, and the telecommunications carriers. Domestic arrangements for Canadian participaiton in CCITT are less formal, and it would seem that the study-group structure established in 1956 is not sufficiently responsive to the variety of contemporary problems; some changes will probably have to be made.

Participation in the affairs of CCIR and CCITT affords the opportunity to promote international standards and procedures that are suited to Canadian needs, and to assist the telecommunications manufacturing industry in its drive to increase exports. In earlier days, the CCITT was effectively under European domination, and its recommendations were related to European practice; meanwhile, Canada was content to follow in the wake of AT&T, a corporation which represents more than half the telephones in the world and is thus a pace-setter and standardizer in its own right. However, the emergence of global networks and, more particularly, satellite communications now makes it necessary for Canada to take a more active part in efforts to align North American and European standards. The principal disparities that have appeared relate to switching, signalling, and now—even more alarmingly—digital transmission. The result is that North American manufacturers find themselves at a competitive disadvantage in markets where compliance with CCIR and CCITT recommendations is manda-

tory. The problem is especially serious for Canadian manufacturers, as compared with their counterparts in the United States; not only is the domestic Canadian market relatively minute, but exports to other countries complying with North American standards are at a disadvantage in competing with the massive vertically-integrated multi-national corporate structures that have developed in the United States.

Within the United Nations organization itself, satellites and space communications have been one of the chief concerns of the 28-member Committee on the Peaceful Uses of Outer Space, established in 1959. The principal concerns are founded, first, on the political and economic advantages that technologically advanced countries might derive from the uncontrolled exploitation of these new techniques, and secondly on the widening of the technological gap between economically developed and developing nations, the fear of 'cultural invasions', and the possible social upheavals that may result. At the same time, it is impossible to ignore the potential benefits for all nations if some equitable exploitation of space communications could be developed.

Accordingly, pursuant to a joint initiative of Canada and Sweden, undertaken at the instigation and with the collaboration of the Canadian Broadcasting Corporation and the Swedish Broadcasting Corporation, the Committee set up a Working Group in 1968 to study the technical, social, political, and legal implications of direct satellite-broadcasting. The Canadian delegation to this Group has, together with Sweden, submitted comprehensive working papers to all three of the Group's sessions; these papers explored the full range of problems to which the introduction of satellite broadcasting services might give rise, and discussed possible solutions. At the third session, the Group endorsed in its report the Canadian-Swedish suggestion that, in order to achieve maximum social benefit from the new activity and at the same time minimize possible friction arising from unwanted broadcast programming, the most practical course of action would be for groups of states to establish their own norms regarding the content and modalities of direct broadcasting within their own regions. For the immediate future, the UN Committee on the Peaceful Uses of Outer Space has decided to keep all developments in this area under close review. Canada, for its part, in conformity with the objectives defined in the White Paper on foreign policy, will "continue support of the United Nations studies on the technical, political, economic, legal, social and cultural implications of direct broadcasting from satellites."

The Committee on the Peaceful Uses of Outer Space has a general co-ordinating function, and its Scientific & Technical and Legal Sub-Committees deal with particular questions, not infrequently involving communications, in their areas of competence. The orderly and equitable development

and use of facilities for space communications can be undertaken only within a frame work of commonly agreed principles governing such matters as access to facilities, the rights and obligations of participating nations, and their responsibilities to the world community. The establishment of such a framework will be no easy task, but Canada is fully committed to its development.

Communications in general, and space communications particularly, have become a subject of increasing interest to the United Nations Educational Scientific and Cultural Organization (UNESCO), of which Canada has been a member since it was formed in 1946. UNESCO is especially concerned with problems related to the free flow of information and the uses of new technology in education and cultural exchanges. This increasing interest, voiced most forcefully at the 15th General Conference of UNESCO in 1968, stems from the possibilities that new modes of communication offer for development purposes, which, in certain circumstances, may help the developing countries to skip an entire generation in communications by obviating the need to establish elaborate and expensive terrestrial networks. The possibility is seen of employing satellites to achieve complete national coverage, including remote and inaccessible terrain, and to bring literacy, education, health information, and agricultural instruction to entire populations.

UNESCO has also been prominent in the attempt of the international community to deal with the legal problem of protection against unauthorized interception and use of satellite transmissions. In December 1969, the Canadian Minister of Communications was elected chairman of a Meeting of Experts on Space Communications, at which many of the issues involved in this problem were discussed. The same Meeting devoted much time to associated concerns relating to the unwanted reception of foreign broadcasts.

The problem of unauthorized interception of satellite transmissions involves more than the protection of copyright, for it affects complete program packages, regardless of whether all or part of their content is subject to copyright. The opportunity arises to 'poach' by tapping whole programs from the satellite system for broadcasting without the authorization of the originator. Existing treaties are not adequate in this regard, and many broadcasters have called for a globally acceptable form of protection for their interests. However, some of the developing countries contend that such measures would widen the existing 'cultural gap' by making free access to programming more difficult, while others are more concerned with protection from unwanted programming aimed at them by more developed countries.

Recent international discussions have been addressed to the formulation of suitable types of agreement on these controversial matters. At the 16th UNESCO General Conference, held in October/November 1970, a resolution was passed to the effect that, following a meeting of experts to be held in

April 1971, the Executive Board of UNESCO would consider convening an intergovernmental conference to prepare a new Convention on the protection of satellite transmissions. This recommendation is in conformity with proposals originally put forward in the joint Canadian-Swedish papers submitted to the UN Working Group on Direct Satellite Broadcasting.

The International Civil Aviation Organization (ICAO) and the Intergovernmental Maritime Consultative Organization (IMCO)[2], which are—like ITU and UNESCO—specialized agencies of the United Nations, are also called upon to deal with various communications matters. Special attention is being paid, particularly in the ICAO Panel of Experts on the Application of Space Techniques, to the potential of satellite systems for improving navigation techniques and affording closer control of aircraft in flight, thereby increasing the capacity of congested air-lanes without sacrificing safety.

The prolonged negotiations for agreement on Definitive Arrangements for Intelsat, previously discussed in Chapter 8, have disclosed several controversial issues. One of these, of particular interest in relation to the Telesat Canada program, was whether membership in Intelsat is compatible with the ownership and operation of separate regional and domestic satellite-communications systems; this has been resolved in the affirmative with regard to domestic systems. A second, already noted, was whether the management function should remain with COMSAT, a domestic carrier for international satellite transmissions which represents the United States in Intelsat, or should be transferred to some international management group. Canada joined several other countries in supporting a compromise that may prove acceptable; this would involve the retention of COMSAT management for the time being, with a gradual transfer to international management. A third question, still unresolved, is whether Intelsat should be governed by an Assembly of representatives of member governments, as distinct from designated operating entities (e.g. COTC for Canada). A likely compromise would assign to the Assembly of government representatives a general responsibility for long-term policy and programs, while the representatives of designated operating entities, meeting more frequently, would be responsible for immediate operating policy.

In general, Canadian objectives in these negotiations are to clarify the role of the organization and the services it may provide, to improve its structure as an international organization (bearing in mind its unique characteristics as an organism that is both inter-governmental and commercial), and to broaden international participation without sacrificing efficiency. Canada is seeking, by these means, to give effect to the objectives set out in the White Paper ("Foreign Policy for Canadians"), which are to "press for the availability of the benefits to be derived from the use of satellite systems on a

[2] Representation on these bodies is, generally, the responsibility of the federal Department of Transport.

global and non-discriminatory basis"; and to "seek the development of organizational and administrative arrangements which will have special regard to smaller non-space states and to developing areas."

The Canadian Broadcasting Corporation is a member, or associate member, of a number of broadcasting organizations, generally regional in character, and contributes specialized representation to conferences where broadcasting matters are to be discussed. Canada is also well represented on several international organizations and associations dealing with professional and industrial matters; while membership of the professional Committee on Space Research is mainly governmental, private participation in other professional and industrial organizations is widespread.

Recent international discussion of new communications technology has focused almost entirely on satellites. Equally dramatic, however, have been the developments in computer technology, and the combination of computer and communications technology to form yet another type of communications facility with immense potential and important international implications. While the problems of computer/communications have not yet been explored within the United Nations organization itself, they were raised by Canada at the 16th UNESCO General Conference. The Organization for Economic Cooperation and Development (OECD) has established a Panel on Computers, for which the Department of Communications has provided a chairman. The ITU, through CCITT, is also studying the technical questions arising from the development of global telecommunications networks for data-transmission, which require specialized techniques different from those employed for voice or television transmission.

Canadian assistance to developing countries, involving telecommunications, is the subject of a Telecommission study report[3] which sets out in some detail the projects undertaken and being planned. Under the bilateral aid program administered by the Canadian International Development Agency (CIDA), telecommunications projects accounted for only 3.3 per cent of expenditures in 1968-69, but covered a wide range of assistance, particularly in applications of new technology such as the provision of communications-satellite earth-stations. In other CIDA programs, such as the provision of opportunity for students and trainees, and the loan of teachers and experts, there has been notably little participation directly related to telecommunications.

The CBC has a long tradition of cooperation with foreign broadcasters, and has been very active in developing countries. The National Film Board has become an international film reference-centre for many countries; in addition to offering training facilities and expert services, the Board has provided special film equipment, built in Canada, to several African countries.

[3] Telecommission Study 3(b).

The Department of Communications has also been active in providing expert advice to CIDA and various international organizations with similar objectives.

Since 1961, the Export Development Corporation has financed exports to developing countries amounting to $109 million, up to 31 May 1970, in the telecommunications sector. This figure reflects the fact that international development projects have been valuable outlets for Canadian production as well as Canadian competence. For many of the recipient countries, assistance in communications represents only a component of programs directed principally to economic growth, which in turn implies social and cultural change. They find it difficult, having regard to other priorities, to take advantage of the fact that efficient communications services can be catalysts for development, while the lack of good communications may be a limiting factor in the rate of development. There is also some evidence that national planners in developing countries have tended to assign a much lower priority than might be expected to the potential of the mass media; it is seldom that better facilities for communications rank with steel mills, power dams, and other conspicuous projects.

The participants in the Telecommission study on this subject[4] regard it as important that, in establishing policy, the effects of communications should be seen in the wider context of contemporary social change, of which development planning and development-assistance planning are important aspects. Their report also refers to:

> "the concept of 'cultural privacy' which is already receiving some attention and will probably come to carry increasing weight over the next decade. This holds that cultures which may be intrinsically rich and satisfying but which are relatively weak in contemporary terms, can neither assimilate inexpensive foreign-produced media content, nor afford to produce material of equally commanding audience impact on their own. Under other names, the concept is familiar to Canadians."

The report also suggests that Canada may be better fitted than any other country to help in finding the answers to some of these problems:

> "Many of the studies of influences bearing on Canada and much of the consideration of appropriate Canadian initiative and response will certainly be of great significance and interest elsewhere." "Other countries may well decide not to follow our models; the significant point is that the models will have been defined and analyzed, and will accordingly offer very important examples and insights for decision-makers in developing countries who will shortly face similar kinds of choice in (telecommunications) policy and operations."

[4] Telecommission Study 3(b).

PART IV

Telecommunications Tomorrow

Where is technology heading? If Canada is to be well served, there should be a domestic capacity for innovation, and an urgent need appears for social as well as technological research in telecommunications. The planning of telecommunications systems to serve all Canadians will require the exercise of great technical ingenuity, and will rely increasingly on the effective use of the radio-frequency spectrum, offering new promise for regional and northern economic and social improvement. Computer/communications systems may transform long-established ways of life and habits of mind through new opportunities for intercommunication, calling for judicious investment of available financial resources and possible changes in the expected pattern of growth for the telecommunications industry.

CHAPTER 10

The Art of Survival

In the current turmoil of dissatisfaction with things as they are, the most common criticism—and one deserving serious attention—is addressed to past failures to maintain a proper balance between the economic and social effects of technological innovation, or even to take the latter into account at all. A clear theme emerging from the Telecommunications studies is that, in the past, the attention and resources devoted to the technological and environmental problems of telecommunications have been disproportionate to their relative importance, and that, in speaking of innovation in this context, both social and technological change must equally be taken into account, and their interactive nature recognized. One of the principal objectives of future telecommunications policy might therefore be to ensure that technological innovation will not be socially detrimental.

Innovation is sometimes the outcome of intuition, or even of fashion or the mere desire for change. More often, it is the result of planned research and development. The expression 'research and development' (R&D) has come to be used so commonly to refer to the whole process of scientific and technological discovery that it is perhaps necessary to attempt a distinction. Research is the investigation of people, matter, and things—what they are, and how and why they act and interact. Research itself may be classified into basic (or pure) research, directed towards the general extension of knowledge, and applied (or mission-oriented) research directed towards the achievement of specific practical objectives. The latter tends to merge into 'development', which is the application of new knowledge to practical and economic use. In the remainder of this Chapter, R&D will be used as convenient shorthand referring to the investigatory process of scientific and technological research and development, taken as a whole; it should therefore be inferred from the separate use of one word or the other that a distinction is intended.

In many circumstances, the process of R&D is a continuum, in the sense that there is often no physical or intellectual separation between the laboratories and persons or groups by whom it is being undertaken. There is also some serendipity in the innovative outcome, for research undertaken in one discipline, or for a special purpose, may fortuitously provide the solution to some problem in another field.

In a recent instance, applied research in telephony led to a discovery that had long been the objective of basic research in astrochemistry. Many eminent astronomers were convinced that ultraviolet radiation and cosmic rays would prevent the formation of organic molecules in outer space; now Bell scientists in the United States, using a newly developed telephone transmission device that makes multibillion-hertz frequencies more easily detectable, have proved the existence of galactic clouds containing ordinary and isotopic forms of carbon monoxide—a fact which profoundly affects conjectures about the existence of life in other parts of the universe.

It can be said, then, that the origins of innovation lie in discovery and experience, and that discovery and experience in one field may lead to innovation in another; thus the value of basic research can seldom be measured in dollars and cents. The interaction of discovery and experience between one field and another also underlies the growing contemporary interest in interdisciplinary research—a concept which is easier to talk about than to realize.

Technological knowledge tends to become international, and in the past Canada has derived immense benefits from close corporate ties with the United States and, to a lesser extent, Britain. But Canada has peculiar geographic and demographic problems, for the solution of which some technologies are better adapted than others that are being more vigorously developed elsewhere. For this reason, a clear need can be seen for a Canadian capability, both for R&D and environmental research in telecommunications, which can be directed towards the solution of problems peculiar to Canada[1]. If the Canadian telecommunications-manufacturing industry is to meet foreign competition effectively at home and abroad, or indeed to prosper or even survive, innovation is essential and, to be commercially effective, requires advance access to new technologies. Moreover, telecommunications research in Canadian universities is one indispensable factor in meeting national needs for professional specialists in telecommunications. In short, the establishment and maintenance of Canadian research capacity is of vital importance.

To an extent, social innovation is also international in character. But it is legitimate to identify a distinctly Canadian civilization—an amalgam, not to be found elsewhere, of particular social, linguistic, ethnic, legal, constitutional, and political structures and habits of mind. This is not to say that this peculiarly Canadian civilization is homogeneous, for—to a greater extent than in many other countries—the balance of its constituent elements differs from one community, province, or region to another. Thus, social problems are often local in kind, whether the locality

[1] For amplification of this point, see "A Science Policy for Canada"—*Report of Senate Special Committee on Science Policy*, December 1970.

is Canada or a single community, and a capacity for social innovation, for which new modes of communication hold so much promise, may thus be a matter of concern for all governments in Canada.

During the course of the Telecommission studies, a questionnaire was sent to every Canadian university that has a graduate program in the social sciences and humanities, asking for details of research projects concerned in any way with the interaction of communications technology and society, together with opinions on research priorities and suggestions for ways of achieving better co-operation between universities, governments, and the communications industry. Advice was also sought from provincial institutes of education, the Canada Council, the National Research Council, the Canadian Radio-Television Commission, the Canadian Broadcasting Corporation, and the National Film Board.

At the time of writing, 135 replies had been received, including some from university departments (such as computer science and engineering) that had not been specifically approached. Unfortunately, a number of institutions failed to reply at all, and in some other cases the meagre answers did not accurately reflect the volume and nature of current projects in this field. Information was received about more than 200 current or recently completed projects, and about some 70 others planned for the future. A standing index has been compiled, and will—it is hoped—be completed and brought up to date on a continuing basis[2].

The inquiry revealed a greater interest and more research in academic institutions than had been expected, and rather less in the communications industry. Some interesting projects came to light, including a few of an interdisciplinary nature. The suggestions of respondents for research priorities are hard to classify, but recognition of the need for interdisciplinary research was clearly shown by the number of proposals for studies in disciplines other than that of the respondent himself. With few exceptions, priorities were stated in terms of the social consequences of technological development, and there was widespread emphasis on the impact of information-transmission systems on language, education, leisure, and the political process. Other areas of concern were the effect of information-systems on inter-regional disparities, on feelings of alienation and conflict, on individual capacity for perception and retention of images and information, and on the potential general condition of 'information overload'. Other proposed subjects of study related to the effects of the mass-media on such matters as individual and group conceptions of national identity, the survival of minority cultures, community and family relationships, and child behaviour.

[2] The University of Toronto has more recently inaugurated an undergraduate course in Computers and Society—the first of its kind in Canada, and among the pioneers in North America.

Several respondents suggested interdisciplinary seminars and study groups without indicating who should organize them, but there were some sceptics who doubted the value of such gatherings unless the number attending is small and the subject for discussion precise. From all the evidence, it appears that there is no easy way for a communications-researcher in one discipline to find out about related work going on in others, and it is surprising that no more than 13 respondents proposed an obviously needed clearing-house for information about current communications-research, which might perhaps be responsible for publishing some kind of periodical or newsletter. There was some support, and some explicit opposition, to the idea of a central research institute on the lines proposed at the Telecommunications Environment seminars[3], or an agency to give central direction to environmental communications research. Other respondents proposed joint projects and the secondment of researchers between governments, universities, and the industry. Almost everybody thought more money would be a good thing, with governments as the most likely sources to be tapped.

Some of the suggestions for research priorities—one, for instance, was 'mass media man, mysticism and media experiences'—lent weight to the cynical view that sociology tends to remain concerned only with imponderables because, as soon as some discipline in the social sciences ceases to be vague, it gets a new name of its own, such as anthropology or economics. The Telecommission studies have exposed some deficiencies in Canadian work in the social and political sciences as they relate to communications. One example is the need for studies of the impact of new technology on the regulation and corporate structure of the telecommunications industry; a great deal of useful research has been undertaken in the United States, but it is not always relevant to conditions in Canada.

Technological research related to telecommunications is undertaken in Canada by the federal Government, by industry, and in universities; both the latter are assisted by government grants. In the telecommunications industry, the principal emphasis in the past has been on applied research and development, but some relatively minor attention is now being given to certain kinds of basic and interdisciplinary research.

Some difficulties are encountered in trying to make a quantitative assessment of telecommunications R&D undertaken or available in Canada. First, there is the phenomenon, referred to above, of interaction between apparently unrelated or only distantly related research disciplines. Second, and more important, it would be erroneous to suppose that the Canadian telecommunications industry benefits only from domestic R&D, for scientific information is freely exchanged by the international scientific community;

[3] See Chapter 3.

also, many important Canadian telecommunications or manufacturing undertakings are affiliated to or have service agreements with multinational corporations, and benefit from the R&D undertaken by the latter. The telephone companies, in particular, derive great benefits from service agreements, which make available in Canada the results of much of the R&D undertaken or sponsored by AT&T and GT&E in the United States. In the manufacturing sector, some important Canadian organizations undertake no R&D at all, either because they are subsidiaries of foreign corporations with R&D operations concentrated outside Canada, or because they are content to rely on technological information generally available, or to manufacture products under licence. In certain instances, however, foreign corporations have been persuaded to assign to their Canadian subsidiaries a global responsibility for R&D related to particular products or product lines.

In the past, the telecommunications industry has tended to focus attention on the development of new products and services; important as they may be to the profitability of the enterprise, a need is becoming apparent for more comprehensive R&D programs. The rapidly increasing complexity and interdependence of telecommunications and data-processing equipment and services demand an overall approach involving R&D on a scale that can be afforded only by governments and the very largest industrial organizations. On no account, however, should it be inferred from this generalization that R&D undertaken by middling and small organizations is valueless, or should be denied Government support for lack of corporate size, since the origins of beneficial innovation are often unpredictable.

In all aspects of R&D there is a speculative factor. Either basic or applied research may lead to a dead end, and development may fail to achieve applications that are economically feasible. Moreover, investments in long-term applied research and development are chancy, for the objectives and circumstances that lead to their initiation may no longer prevail when they have been completed. Those responsible for R&D expenditures are faced with the difficult task of balancing costs against not only the chances of success but also the necessary degree of success, regardless of whether success is measured in terms of profitability, good publicity, or the public interest. Whoever accepts the risk and takes the initiative must assume the responsibility, but the responsibility can sometimes be shared. It follows, then, that governments must take the initiative for those R&D projects that are necessary in the public interest but do not commend themselves to industry as acceptable risks. Governments must also undertake full responsibility for R&D in the public interest where the nature of that interest cannot be divulged, either on grounds of national security or because advance information would place the recipient in a commercially advantageous position. However, in the latter case, shared responsibility need not be

ruled out if it is possible to establish some guarantee that the results will be freely and immediately available to competitors.

Finally, government assistance for R&D may be justified where the public interest is held to be more important than the private interest, or where the element of risk in a project that is in the public interest may be larger than a private undertaking can reasonably accept. Healthy innovation can also be stimulated by the government through the enunciation of national scientific objectives, through the encouragement of international exchanges of information, through an enlightened purchasing policy, and generally through the encouragement of domestic economic growth.

It is estimated that, in 1969, total expenditures on telecommunications R&D in Canada amounted to some $94 million. The federal Government spent about $38 million, made up of $7.5 million on in-house R&D operations, $26 million in grants to industry, and $4.7 million in grants to universities or academic scientists. Net expenditures by industry amounted to $56 million, but total activity in the private sector is estimated at $82 million. The single largest telecommunications research establishment in the country is that of Bell Canada-Northern Electric Limited[4]. In 1969, its total expenditure directed to research exceeded $41 million. Of this amount, government assistance amounted to less than 10 per cent.

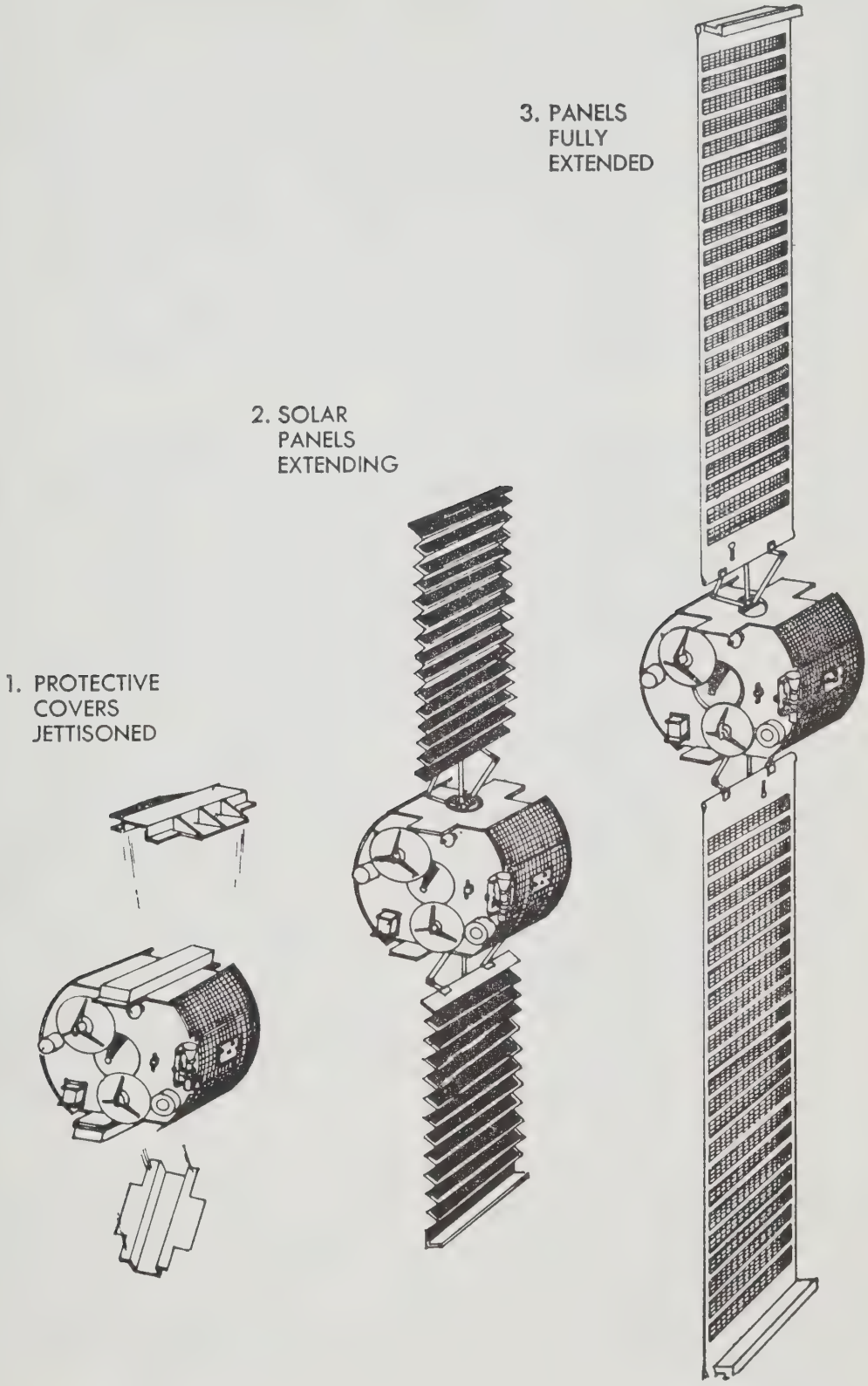
Telecommunications research in universities accounted for some $5 million, of which 75 per cent was derived from grants by the National Research Council (NRC), 9.6 per cent from other federal Government sources, 10.2 per cent from private foundations, 3.4 per cent from industry, and only 1.7 per cent from general university funds.

Although some of the research undertaken by the NRC in its laboratories is directly or indirectly relevant to telecommunications, the principal federal Government operation is that of the Communications Research Centre (CRC), formerly the Defence Research Telecommunications Establishment under the Defence Research Board and now a branch of the Department of Communications. One reason for the transfer was the need for a wider Canadian telecommunications research program to meet both civil and military requirements. About three quarters of CRC manpower is now applied in the civil area and one quarter in the military.

Among the many outstanding achievements of this research establishment has been the ALOUETTE/ISIS satellite program. Canada became the third country to have a satellite in space when ALOUETTE *I*, built in the (then) Defence Research Board laboratories, was launched from California in 1962 by a NASA rocket. Its successor, ALOUETTE *II*, was the product of co-operation between Canadian government and industrial engineers, and both satellites are still in orbit and transmitting valuable information. ISIS *I*, also built under

[4] A newly incorporated subsidiary of Bell Canada under which the formerly separate research establishments have been merged.

COMMUNICATIONS TECHNOLOGY SATELLITE



ARRAY DEPLOYMENT

a joint program with the United States, is larger and more complex than any other satellites in orbit, except those of the United States and the Soviet Union, and a second satellite in this series is to be launched early in 1971.

A significant event for CRC has been the recent decision to plan for a communications technology satellite in co-operation with NASA. The principal objectives of the project are to develop and flight-test new communications concepts and systems, including operational experiments with earth-stations in various parts of Canada and the United States. Studies are being carried out to determine the spacecraft configuration and weight, to design the experimental systems, and to provide cost estimates. Features under discussion include high-power transponders[5] that would make possible television broadcasting direct from a satellite to community receiving antennas; large unfurlable solar power arrays delivering 1.5 to 2 kilowatts of power; and stabilization systems for a spacecraft with flexible appendages and thermal control techniques.

The general function of the Communications Research Centre is to analyze the contribution that communications systems can make to the achievement of national objectives, and to try to ensure the timely introduction of modern systems and techniques. The program is broadly classified under communications systems, space programs, and supporting research. This includes research into advanced methods for communicating and processing of information and the application of these techniques to Canadian problems. It covers earth-satellite projects for investigating the factors that govern terrestrial and space communication, and for investigating spacecraft and communications technologies to be used in future Canadian communication-satellite systems. Supporting research includes broadband techniques and devices, failure analysis (particularly of devices and integrated circuits for space systems), and computer-aided electronic circuitry design. Studies of radio propagation and noise (interference) at a wide range of frequencies are undertaken to increase understanding of the effects of the earth and its atmosphere on communications, and to support the licensing and regulatory functions. The 1970-71 budget for CRC is $14 million, including $2 million for military effort and $4 million for outside research and development contracts.

The extramural research capacity of the Department of Communications will be expanded in the fiscal year 1971-72. A new research program, which has been funded in excess of $300,000 for the first year, will allow the Department to extend its activities in promoting mission-oriented research within universities, not only in the physical sciences and technologies of communications but also in their socio-economic aspects. One of the

[5] A transponder is a device which, upon receiving a designated signal, emits a signal of its own transmitting the information received.

objectives of this new program is to promote, wherever possible, interdisciplinary communications research.

Other Government assistance to R&D undertaken by industry is provided under five programs: the Defence Industry Productivity Program (DIPP), the Program for the Advancement of Industrial Technology (PAIT), the Defence Industrial Research Program (DIRP), the Industrial Research Assistance Program (IRAP), and grants under the Industrial Research and Development Incentives Act (IRDIA). Industrial recipients of grants under most of these programs must share the cost of the R&D projects for which they are provided, usually on a fifty-fifty basis. A prime objective is to foster imaginative risk-taking by Canadian industry.

The Executive Committee of the Canadian Radio-Television Commission (CRTC) is authorized under the Broadcasting Act (s. 18) to "undertake, sponsor, promote or assist in research relating to any aspect of broadcasting". The Commission is extensively engaged in studying the availability and range of broadcasting services in all parts of Canada; the social, economic and legal factors involved in the licensing of broadcasting undertakings; and the institutional and technological factors that determine the quantity and quality of programming. Research is also directed to the identification, definition, and classification of the forms, contents, and functions of programs as a basis for the examination of programming proposals and their implementation in terms of the regulations promulgated by the Commission, and of the conditions attached to licences.

The CRTC is concerned with the assessment and forecasting of social and technological trends and indicators of change that may affect the evolution of the broadcasting system. A number of special inquiries in depth relating to particular aspects of broadcasting have been undertaken. Among these were wide-ranging studies on the extension of broadcasting services in different parts of Canada, and co-operation with the special Senate Committee on Mass Media and the House of Commons Committee on Election Expenses. The Commission also undertook a detailed examination of the techniques of production and presentation of controversial issues by the public and private elements of the broadcasting industry.

The Canadian Broadcasting Corporation is also engaged in an extensive audience-research program. This is a continuing enterprise directed towards the planning and production of programming for both the English and French national networks, with particular emphasis on the development of Canadian content and the extended employment of Canadian talent.

Government-supported university research projects are sometimes initiated by the department or agency making the grant. More often, however, the initiative comes from a particular scientist or group of scientists working on problems that may be of special or general interest in relation

to government policy. While grants for projects undertaken by individual scientists seldom exceed $15,000, assistance is also provided for larger projects undertaken by groups of scientists, which may extend over many years and involve grants up to as much as $1 million in all.

In Canadian universities, several factors have tended to militate against the establishment of research teams for important long-term projects and their economical operation. The relatively narrow interest of an academic researcher may shift to another subject when he has attained some personal objective in a research project, although its continuation might be extremely valuable in the public interest. Movement from one university to another, which is frequent among younger scientists, may also entail a change of direction in research. These conditions do not apply to the same extent in research institutes or agencies that have no academic affiliation. But, although student participation in research is not always conducive to economy in time or expenditure, its educational value is so important as to justify consideration of means to improve the extent and continuity of government-aided communications research in Canadian universities.

The total volume of R&D expenditures by industry often forms only a small part of the total cost of innovation. For new mass-produced equipment, the costs of tooling and marketing may represent up to as much as 85 per cent of the total cost of innovation, only 15 per cent being attributable to R&D. However, R&D may constitute as much as 50 per cent of the innovation cost of more complex or specially assembled systems or products. It is not a simple matter to establish criteria for judging the efficiency of R&D programs in general, or for telecommunications in particular. The success or failure of research undertaken in government and university laboratories can seldom, if ever, be measured in dollars and cents. In industry, too, where some studies suggest that as much as 80 per cent of R&D is eventually sterile, profitability is by no means always the sole objective.

An attempt has been made, nonetheless, to establish a background of national objectives against which the effectiveness of Canadian R&D may be judged. It is suggested that Canadian R&D capability should be on a scale to ensure the efficiency and accessibility of national telecommunications systems and networks; to enable the telecommunications manufacturing industry to compete effectively in domestic and international markets; to develop a body of professional manpower for the advancement, comprehension, and analysis of technological improvements and their impact on national social and economic objectives; and to establish a base for the prediction of advances in telecommunications technology and the problems they may cause. Measured against these broad objectives, it can be said that telecommunications R&D activity in Canada, so far as it goes, has made a positive contribution and been relatively effective.

It is difficult, however, to judge the effectiveness, in relation to these objectives, of small isolated activities in universities or industry. There is a real tendency for research to be self-perpetuating, and one recalls Swift's Laputan who "had been eight years upon a project for extracting sunbeams out of cucumbers". In larger integrated projects, too, it is often difficult to determine the point at which potential benefits become marginal. There is also a practical difficulty in establishing priorities for R&D projects addressed to different objectives, and it is suggested that there is no feasible alternative to a combination of objective quantitative analysis and subjective value-judgments.

The increasing complexity of telecommunications R&D suggests that, for a proper determination of priorities, there may have to be a closer association between those responsible for telecommunications policy and the management of R&D activities in government, industry, and universities, so as to achieve a clear understanding and agreement on objectives and the means by which they may be attained. A high degree of flexibility in the establishment of priorities and allocation of resources is essential if the greatest benefits are to be derived. Some participants in the Telecommission studies suggest a need for some unspecified kind of administrative machinery for the periodic review, by all concerned, of the objectives of telecommunications policy and the strategy of related R&D.

To a large extent, the efficiency of Canadian telecommunications R&D is dependent on the availability and exchange of information, so that a measure of co-ordination can be achieved through more widespread knowledge of contemporary activities. The Telecommission Project Team[6] dealing with this subject has said that, with the outstanding exception of the Bell/Northern Electric complex, any large-scale coordination of Canadian telecommunications R&D has been more fortuitous than planned. The grants committees of the NRC have acted as coordinating agents to a certain extent, particularly with regard to university research, and the same may be said of the Government programs for supporting R&D activities in the industry. However, as the level of activity has increased, and as the field of research has expanded, *ad hoc* arrangements have become fragile, and a need has become apparent for more closely planned attention to the relationship between R&D activity and national objectives.

Telecommunications technology is highly dependent on the rapidly advancing development of electronics, now perhaps the most fertile field for scientific discovery and technological innovation. The introduction of comprehensive systems is heavily dependent on a high level of R&D activity. Coordination is a prerequisite if the maximum benefits are to be derived

[6] Telecommission Study 4 (b).

from a given level of expenditure, but is difficult to achieve among widespread activities in government, industry, and universities.

Representatives of the telecommunications industry, particularly the carriers, stress the advantages of corporate integration of R&D related to operations and manufacture. But it must also be recognized that the introduction of advanced systems and techniques by the industry is inevitably constrained by the characteristics of existing systems, many of the elements of which are no longer suited to contemporary requirements. This is a factor to be taken into account in the formulation of Government policies for support of R&D related to national objectives; once these objectives have been enunciated, the functions of planning and coordination will be greatly facilitated.

It seems clear that a new dimension in the extent of planning and coordination will be required, and that broader and deeper studies will be necessary. Industrialists, as a class, tend to shy away from proposals for government planning and coordination, and as a result governments tend to take the risk of the most expensive and problematic research projects, from which—if successful—the industry may derive the greatest benefit. It seems important, therefore, that the telecommunications industry be invited or even urged to participate in the formulation of R&D objectives and in the planning and coordination of telecommunications R&D related directly to the special needs of Canada.

The problem remains of finding means to associate the communications research work of the social and political scientists with that of the technologists, so that new developments can be looked at from all angles before commitments to new policies are settled. The need for effective communications underlies the whole structure of society, and policy problems are now so complex that balanced decisions cannot be expected unless there has been some interdisciplinary pre-digestion of contributing factors. Those who make policy, and their advisers, must be able to strike a balance between different considerations, each requiring some special knowledge for its comprehension. In communications particularly, there is an obvious need for people who now seem to be called multi-disciplinary decision-makers; it seems a pity that the word 'generalist' has acquired an almost pejorative sense.

The requirement is not only at the top, where at least a nodding acquaintance with all the relevant sciences is required. It extends, of necessity, down into the decision-making structure, in a descending scale of multi-disciplinary competence. There is a point in the scale at which the specialist, if he is to move into the policy-making structure, must become at least bi-disciplinary, and people who are bi-disciplinary, let alone multi-disciplinary, are in notably short supply.

A survey[7] was undertaken by the Department of Communications with the object of identifying the probable future demand for multi-disciplinary executives in Canadian communications organisms, and assessing the sources of supply. In the Department itself, there is an immediate shortage of executives who are articulate in almost any permutation or combination of disciplines such as communications engineering, systems engineering, experimental science, law, regulatory matters, economics, and 'behavioural science'.

The survey was undertaken through a questionnaire addressed to other federal departments and agencies, provincial and municipal governments, the telecommunications carriers, the broadcasting industry, and all Canadian graduate schools. Opinions were sought on the combinations of disciplines most pertinent to an understanding of communications problems, with estimates of present and foreseeable needs for people with one or more of such qualifications. Respondents were asked what methods they use, or contemplate, for meeting those needs, and what course of action they might recommend for improving the sources of supply. The results of the survey, perhaps not surprisingly, were inconclusive.

Among one-track specialists, the prime needs seem to lie in systems engineering and communications engineering, followed by law, regulatory matters, economics, communications arts, and the behavioural sciences. No combination of particular disciplines emerges as significantly more important than any other, but rather a mixture of one of the technological or physical sciences with one of the social or political sciences. Respondents in federal departments and agencies, and among the broadcasters, tended towards the view that sources of supply are insufficient, but the problem is not regarded as serious by most provincial respondents. Only the telecommunications carriers, or at least some of them, appear to have well-established but flexible programs for recruitment and career planning.

In the universities, graduate programs in communications sponsored by engineering departments often suffer from lack of academic staff, of graduate financial assistance, and of research equipment and training facilities. These deficiencies are said to be even more serious in communications programs sponsored by departments in the social sciences and humanities. There appears to be general agreement that graduate students in engineering and applied sciences should be allowed (or perhaps required) to take courses in the social sciences or humanities, and *vice versa,* although the complexity of administering multi-disciplinary programs is a serious problem. Developments on these lines would require outside assistance in forecasting demand in kind and quantity.

Several other proposals for future action were made. Respondents from government and industry endorsed the value of in-house development of

[7] Telecommission Study 7(e).

multi-disciplinary executives through career planning, including temporary detachment from duty while undertaking extended university studies. There was some agreement that further consideration might be given to the development of a tightly controlled rotation program between governments, industry, and the universities, under which promising executives or academic specialists could be seconded for temporary duty in another sphere of activity. Suggestions that special communications institutes or training programs might be supported or sponsored by the federal Government did not commend themselves to the telecommunications carriers.

Only two clear conclusions can be drawn from the survey of professional manpower requirements. First, it appears that more detailed inquiries will have to be undertaken to bring into perspective the problem of ensuring a sufficient supply of professional manpower to deal with Canadian communications problems. Second, there was general agreement that consideration should be given to the initiation of multilateral discussions involving governments, the telecommunications industry (including broadcasting), and Canadian universities, with the object of assessing the gravity of the problem and the best way to deal with it.

CHAPTER 11

The Crystal Ball[1]

In the past, the time between the discovery of a basic technology or device and its practical exploitation with significant impact on the life of the general public has usually been at least 20 years. If it be accepted that this development period is likely to persist, as is expected, the basic technologies that may be used in the development of telecommunications during the next two decades are probably already known, but implementation must await significant cost reductions, either by further technical development, or by improved methods of fabrication, or through the development of large markets.

A generalization of this kind must, however, be treated with caution. Certain new technologies or new components have often been put to use in much shorter periods, but usually without having a significant impact on the life of the general public. Moreover, the critical spark that ignites a revolutionary change is all too often generated by some obscure work in a field regarded as trivial when predictions are being made. The sudden insights, or flashes of inspiration, that lead to important new inventions are intrinsically unpredictable, and there is always the possibility that plans based on the best information available may be rendered sterile.

A simplified account of current telecommunications technology has been given in Chapter 2, and it may be useful to give here a brief review of the chief developments during the last 15 years. From the late 1950's, the construction of coast-to-coast microwave links revolutionized the transmission systems of the telephone and telegraph networks, as well as facilitating the provision of connections for the television networks. The invention of the transistor in 1948 resulted in an explosive development of solid-state technology[2], with semi-conducting devices[3] progressively replacing tubes in most applications, and especially in logic or switching circuits. Micro-electronics have had a vast effect on the size, speed, and cost of computers, which—in addition to their more commonly known functions—have become indispensable to network control and switching operations.

[1] For greater detail of future technological developments, see Telecommission Study 4(a).

[2] A 'solid-state' component depends for its operation on the control of electric or magnetic phenomena in solids.

[3] A 'semi-conductor' is a material with resistivity (i.e. the reciprocal of its conductivity) between that of insulators and that of conductors.

The most recent computers are a million times faster than the 1944 prototype, and internal speeds have increased by a factor of 200 between 1955 and 1965. A computer which occupied 1,000 cubic feet in 1955 required only 100 cubic feet in 1965, and the cost of performing one million additions decreased from $10.00 to two cents in the same decade. Perhaps the most significant developments of all have been those associated with remote-access computer facilities and the demand for higher network speeds. The techniques of time-sharing and equipment-sharing, and of digital telecommunications have led to the first stages in the establishment of the new computer-utility industry.

For the future, it can be said that the development of the Canadian telecommunications system is likely to be shaped by three principal requirements. An increasing demand is foreseen for a variety of narrow-band and broadband services, coupled with pressures for universal access on an equitable basis, offering opportunities for increased participation in political and community affairs. In broadcasting, there is likely to be growing public acceptance of on-demand programming, in parallel with and as an alternative to scheduled services, perhaps through the medium of broadband distribution systems. Population spread and measures for the relief of urban congestion are expected to lead to much heavier demands for mobile communications. The characteristics, structure, and cost of optimum telecommunications systems will be affected by demographic changes which are difficult to forecast with any degree of assurance.

In basic technology, continued research and development on the control of microscopic, molecular, and atomic processes are likely to result in new multiple-function high-speed devices which can be quickly and cheaply fabricated. Large-scale integration (LSI) techniques will reduce the cost and size of sub-units by a factor of about 30 times in the latter half of this decade, and will facilitate extended automatic control and maintenance. All active communications equipment, except that with high output power, will be made from solid-state components. More esoteric research will continue to be addressed to the possibility of transmitting all five senses, instead of only sight and sound. It has ever been said, probably apocryphally, that the only serious research on extra-sensory perception is being undertaken by the Bell Telephone Laboratories in the United States.

Large memories are vital to communications technology, and to all aspects of data processing and display. Human memory can be supplemented by all the knowledge stored in libraries, museums, film collections, archives, and documentation and research centres. But the practical availability of all this knowledge, however efficiently catalogued, has been limited in the past by geographical dispersal and the time consumed in physical search. The distinguishing feature of computer memory, in conjunction with tele-

communications, is that the entire body of electronically stored knowledge, wherever it may be located, can be easily and rapidly searched, identified, and exposed on a selective basis from a distance.

Data are stored in electronic memories in digital form, and each unit of information is known as a single bit[4]; a megabit (Mbit) is one million bits. Existing computers have internal transfer speeds up to about 400 Mbits per second, permitting speeds up to 5 million operations per second; it is expected that, by 1975, as a result of new 'compression techniques' in computer architecture, speeds will increase by another factor of 200, permitting computer operations at a rate of a billion per second.

There are many types of electronic memories, which are differentiated in relation to such factors as reliability, cost, dimensions, speed, and power consumption. Ferrite-core memories, which are 'not volatile' (in the sense that they retain information without applied power) have many advantages and are expected to have a dominant position until at least 1980. Semi-conductor memories now under development, which will be especially suitable for small computers, are likely to come into widespread use after 1980; although likely to be much cheaper, most forms of semi-conductor memories are 'volatile' and therefore not interchangeable with ferrite-core memories.

The decade 1980-90 may see the introduction of 'magnetic-bubble'[5] and holographic[6] memories with greater storage density at a much lower cost. The storage density in serial-access bulk-storage memories may increase by a factor of about 100 over the next 20 years. In the shorter term, it is predicted that a computer occupying 100 cubic feet of space in 1965 will require only 1/10 of a cubic foot by 1975, and that the cost of performing a million additions may be reduced from about two cents in 1965 to 1/200 of a cent during the present decade.

Computers can now scan and record documents, graphics, film, and videotape, which can later be retrieved and projected visually by several means. The most common, at present, is the cathode-ray tube, which may be replaced by new devices using compound semi-conductors. Some of these operations are facilitated by the use of 'canned' programming devices but computers have another, more sophisticated and much more important, talent. They can be programmed to display, as well as conventional pictures and facsimiles, all kinds of data in a visual dynamic form, co-ordinated as regards time, space, and dimension. For example, historic, geographic, and demographic trends are often difficult to deduce or infer from massive

[4] 'Bit' is an acronym derived from 'binary digit'.
[5] A technique for storing large amounts of digital information in an extremely small volume, perhaps up to 100 Mbits/cu. in.
[6] Holography is three-dimensional photography using laser light.

statistical data; the same data, after digestion and correlation by a computer, can be displayed visually in the form of continuously changing images that make the nature, dimensions, speed, and projection of the trend immediately and easily perceptible.

These techniques may eventually provide new insights into such problems as urban planning, population changes, regional and social disparity, transportation, housing, and pollution by presenting the complex facts in a simple visual way. Computer-generated moving images can also be simulated to depict situations and environments that are abstract or only conceptual; visual display systems can now present pictures that cannot be seen in nature. A computer working from mathematically expressed data can produce a see-through three-dimensional picture of a rotating object. Displays of characters, vectors, and curves can be drawn by computerized generators; these are costly, but high-speed digital circuits can be used, permitting a single generator to be shared by a number of remote display terminals.

A feature which has obvious importance for architecture and all forms of technical and artistic design is that the displayed image can be changed, and the change recorded, through various simple devices, including a 'light pen' which can be used to change the image (and record the change) by pointing it at the display-screen. Data-display devices, although still generally very costly, are already in widespread use for purposes such as management information, process control, air traffic control, information retrieval, pattern recognition, graphic arts, and computer-aided design and instruction. Some of the most sophisticated display devices are free-standing and computer-driven, with a large complement of interactive devices. At present, telephone lines and suitable terminal equipment are used for most of the remote display systems connected to a computer on a time-sharing basis, but many display terminals require a higher rate of data transfer than the present telephone network can economically provide.

Semi-conductor technology, together with micro-electronics, integrated circuits, and medium-scale and large-scale integration will provide continuing improvement in computer memories and logic. It is not only the enormous reductions in size and weight of electronic components that are revolutionary—important as they are for space technology and portable applications—but rather small size combined with improved reliability in performance, greater circuit sophistication, and lower cost. Very rapid progress has been made during the last few years in integrated circuits. For example, between 1968 and 1970, the density of random-access chips has increased from 400 to 1,000 bits/sq. in.; arrays of 300 chips are now being made on a 4″ × 5″ substrate[7], with 4,000 components on each chip.

[7] 'Substrate' is the physical material on which a micro-circuit is fabricated.

The ultimate limit on bit density is not the ingenuity of the designer or the processing of the chip, but the dissipation of the heat generated in operation.

Large-scale integration for electronic circuits in applications such as digital filters will allow a substantial cost reduction in FDM-type carrier equipment in the period 1975-80. Beyond 1975, cost reductions in digital TDM equipment will offer even greater benefits. The use of digital-code modulation systems will provide more efficient use of the radio-frequency spectrum on a geographical re-use basis, if proper frequency assignments can be provided.

Many uses are foreseen for small low-cost free-standing computers—a car with computer-controlled gas flow is in operation today—and it is possible that they will complement rather than detract from the demand for remote-access time-sharing services. Mini-computers, in mass application at user locations, will also act as concentrators for interaction with large remote computers or memory banks, where additional processing ability or centralized storage may be required. The result, for the majority of remote users, will be shorter holding-time and lower channel-capacity requirements than those predicted in the past.

The nerve centres of the carrier networks are their switching offices. The most advanced networks in the world—those of North America—are extensively equipped with wired, common control, mechanical cross-bar systems today. Much of the rest of the world, and even many regions of North America, are still getting by with much older step-by-step equipment. It is expected that by 1975 a fairly general introduction of semi-electronic switches will have begun. These will use stored-program computer technologies in their control sections but will still rely on electro-mechanical devices for making connections. The reaction times of such systems will still be in the range of milliseconds. The design of all-electronic computer-like switching systems capable of functioning at microsecond speeds and handling hundreds of megabits through their junction networks is only in the exploratory stage.

Future switching systems will easily handle the complex features required for voice, data, video-program, and voice-program switching, using time and space division. Existing analog space-division switching will be complemented with time-division and space-division PCM switching, starting in the late 1970's or early 1980's. The actual switch matrices will gradually be dispersed throughout the network rather than concentrated, making the distribution links shorter and of higher quality. The network will evolve with larger central processors serving many matrices. These processors in turn will be tied together with common data-signal channels to form a true 'common control network' rather than the existing 'progressive network'. The evolving

carrier networks may be composed mainly of digital sub-systems, which will offer the complete range of digital and analog capability required by any user on a switched-network basis. The rate of innovation and of introduction of new techniques is no longer a question of invention and design but of the ability of carriers and users to dedicate the billions of dollars required for development and for plant renovation.

It seems likely that the growth of telecommunications requirements will call for the use of systems with extremely broad bandwidths, which might be provided by now-unused frequencies in the uppermost reaches of the spectrum. They range continuously from wave-lengths of a few centimetres through the millimetre and infra-red wavelengths, to the region of visible light, and may eventually even include the ultra-violet range. A communications system in which the signal is carried on the light beam of a laser[8] will provide a transmission capacity equivalent to many million voice channels. Practical communications systems using lasers have been designed and demonstrated in the laboratory, and a complete system could be put together with equipment now stocked by several manufacturers, but economically competitive transmission techniques have yet to be developed.

In the millimetre waveband, over 200,000 voice channels or their equivalent could theoretically be accommodated by each system, but a serious obstacle is that, at these frequencies, the atmosphere causes the signal to deteriorate. To overcome this effect, known as atmospheric attenuation, several forms of waveguide are being developed; one consists of a steel pipe, 2″ in diameter, containing a copper-wire helix embedded in plastic; by using a circular electric wave in this waveguide, the energy lost in transmission can be dramatically reduced. Another form, described as a 'dielectric guide', uses a copper tube with a non-conducting coat. However, the economical use of millimetre-waveguides for long-distance transmission requires further engineering development.

Atmospheric attenuation might, however, be turned to advantage for some purposes, particularly for CATV and other one-way distribution requirements, because interference between millimetre-wave signals can occur only in a very small area. A low-power radiating distribution system, using many short relays, could be devised, which might be economically attractive in cities. Small relay units could be installed on utility poles or lampposts along city streets at intervals of 300 feet; each unit would receive a signal from its nearest neighbour and rebroadcast to three other units in different directions. Home reception would be through an inconspicuous receiving array aimed at the closest repeater.

Solid-state technology and its multiple applications, ranging from wireless and lens-less cameras to satellite transmission, may lead to significant

[8] 'Laser' is an acronym for Light Amplification by Stimulated Emission of Radiation.

changes in broadcasting programming, production, and distribution. By the 1980's, a variety of apparatus—compact, light, autonomous, totally mobile, and relatively cheap—will make the radio and television media ubiquitous, offering wider dimensions of insight and participation. On-demand programming distributed by broadband systems may result in some decline in the volume of television-studio production; on the other hand, greater use of FM radio and the introduction of UHF television transmitters, also offering a wider range of choice, may have a balancing effect.

Television receivers are expected to become more reliable and cheaper, and semi-conductor devices are expected to replace all vacuum tubes by 1975. Cathode-ray tubes will be improved, and perhaps replaced around 1980 by flat solid-state screens giving larger colour or black-and-white pictures. Towards 1990, three-dimensial television may be made possible by the use of lasers and holography. Television will be accompanied by stereophonic sound, and double or multiple channels will be available for multilingual programming if there is sufficient demand when the present cost has been substantially reduced.

The growing congestion of traffic in the air and on the water presents problems which may be lessened by advanced techniques for mobile communications, but growing congestion in the radio frequency spectrum—which is the only available medium of transmission for mobile services—may necessitate reassignment of bands now dedicated to other services. Scan-hunting for free channels (already in use for certain purposes) may be generally available during the 1970's, and additional capability will become economical during the 1980's through the use of band-compression techniques and frequency-synthesization devices, such as 'vocoders'[9] and their visual equivalents. New and more sophisticated air-navigation recording and control systems are being introduced, which will greatly expand the needs for transfer of many types of intelligence, perhaps leading to an integrated communication, navigation, and identification system.

On the ground, the number of vehicles in use for recreation and other purposes in wilderness areas, particularly in winter, is likely to grow rapidly. A need is foreseen for very economical mobile communications and navigation-aids, but there are likely to be increasingly serious problems of spectrum crowding. On autoroutes, the concept of the 'electronic road'—providing fully automatic driving and traffic control—might be in limited operation by 1990.

In the whole field of telecommunications, the most revolutionary changes in the next two decades are likely to be brought about through rapid developments in space technology. Satellite communications systems are particularly well suited to the geography of Canada, where the wide

[9] A 'vocoder' is a device for compression of the bandwidth of speech.

distribution of resources in areas where terrestrial communications cannot be provided on a commercial basis justifies a policy of providing satellite communications for domestic use. The first such system is expected to be in operation in 1973. Later types of domestic communications satellites can be foreseen which will offer a flexible nation-wide communications system using small, cheap and readily transportable ground terminals, and community-type broadcast services which can be received on installations adding ultimately as little as $100 to the cost of the domestic TV receiver. However, the number of channels that could be provided to any one location may be limited, by high costs, to a level well below the combined urban capacity of broadcasting channels and broadband distribution systems.

Laser transmission has certain inherent disadvantages for use in both terrestrial and satellite telecommunications systems. The attenuation of electro-magnetic waves by the atmosphere increases as the frequency gets higher; but there is a 'window' in the infra-red region of the spectrum where normal atmospheric attenuation is much reduced, and this happens to coincide with the operating frequency of the powerful carbon-dioxide laser. The useful role of communications satellites could be greatly extended should it become possible to take advantage of this infra-red 'window' in the atmosphere by using the carbon dioxide laser for the up and down links of a high-capacity communications network. However, the practical problems of transmitting through layers of cloud or fog have not yet been resolved, and are likely to remain intractable except for fairly low data-rates.

Communications satellites with a capacity of up to 80,000 voice-channels are already in the early stages of planning and design, but the most important development to be expected is that it will eventually no longer be necessary to pre-determine the entire functional life of a communications satellite before it is launched. The main thrust of the post-Apollo space program in the United States during the next decade is likely to be directed towards the development of manned space-stations, which can be served by re-usable vehicles capable of transporting men to and from the earth, and from point to point in space. These space-stations will be designed not for professional astronauts but for communications engineers and other specialists engaged in the installation, operation, maintenance, and modification of satellite-communications services.

In this brief account, addressed to the layman rather than to the specialist, of the possible future of telecommunications technology in the next 20 years, a conscious attempt has been made to bring into perspective some of the wilder surmises so often aired in the press. The predictions of sober scientists are startling enough, and it can no longer reasonably be

doubted that profound changes are in the offing. There can equally be no doubt that unremitting effort and attention will be needed to eliminate or at least control the possible anti-social by-products of the technological revolution, while at the same time striving to put new opportunities to the best use. What is needed is a sustained effort to foresee the social and economic effects of new technology, and to plan accordingly as far in advance as possible. The planners may often be perplexed but, like a blind man feeling his way about carefully and perceptibly, they are likely to achieve better results than a dare-devil man who strides confidently into unknown territory with his eyes shut tight.

CHAPTER 12

A Common Communications Space

The Minister of Communications has a statutory responsibility[1] "to promote the establishment, development and efficiency of communication systems and facilities for Canada." Among the means available for the fulfilment of this responsibility is the management of the radio-frequency spectrum, for radiocommunication is an increasingly important component of many telecommunications services. Under the Radio Act[2] the Minister is empowered to issue radio licences (or 'technical construction and operating certificates' for broadcasting undertakings) to which he may attach "such conditions as he considers appropriate for ensuring the orderly development and operation of radiocommunication in Canada."

It may be helpful to make yet another short technological digression here into the nature and characteristics of the spectrum. Electromagnetic radiation is radiant energy resulting from acceleration of an electron or other charged particle. The existence of an electromagnetic frequency spectrum was hypothesized by Clerk Maxwell in 1864, and radio waves were detected by Hertz in 1888. They may be characterized by wavelength—the distance between one peak or trough and the next—or by frequency—the number of peaks that pass a point in a given time. For any electromagnetic wave, the arithmetical product of wavelength and frequency is always equal to the speed of light.

Frequency is measured in terms of cycles per second, and the unit of measurement is the 'hertz', or one cycle per second. A 'kilohertz' (kHz) represents a frequency of 1,000 cycles per second; a 'megahertz' (MHz) is 1,000 kHz, a 'gigahertz' (GHz) is 1,000 MHz, and a 'terahertz' (THz) is 1,000 GHz. Frequencies below 10 kHz are not suitable for radiocommunication, but the radio spectrum ranges up to 3 THz (or three million million cycles per second). For convenience, the designations in Table 4 are generally used to describe the radio spectrum.

It should not be thought that the whole of the spectrum is technologically or economically available, and in fact it has been allocated[3] internationally only up to 40 GHz. The propagation characteristics of the spectrum change

1 Government Organization Act, 1969, s.10(1)(b).
2 s.2B(1)(b); for a description of the Radio Act, see Chapter 19.
3 A semantic distinction is drawn between the 'allocation' of frequency bands for defined purposes and the 'assignment' of frequencies for particular uses.

Table 4. The Radio-Frequency Spectrum

Up to – 30 KHZ	Very Low Frequency (VLF)
30 KHZ – 300 KHZ	Low Frequency (LF)
300 KHZ – 3 MHZ	Medium Frequency (MF)
3M HZ – 30 MHZ	High Frequency (HF)
30 MHZ – 300 MHZ	Very High Frequency (VHF)
300 MHZ – 3 GHZ	Ultra High Frequency (UHF)
3 GHZ – 30 GHZ	Super High Frequency (SHF)
30 GHZ – 300 GHZ	Extremely High Frequency (EHF)

with the frequency, so that some parts of the spectrum are better suited to certain purposes than others. At the lower end (VLF and LF) the radio waves tend to follow the curvature of the earth, and are useful for reliable long-range communication through relay stations. In the MF and HF ranges, advantage is taken of the fact that these waves are reflected from the ionosphere, and they are used for long-distance (but less reliable) radiocommunication and international broadcasting.

Frequencies in the VHF range and above have two characteristics that limit their use; they are progressively blocked by surface objects and attenuated[4] by the atmosphere, and are therefore useful only for satellite communications and terrestrial transmission over line-of-sight paths. Up to 1 GHz the spectrum is well suited to simple systems, such as FM broadcasting (sound and television) and mobile communications (land, aeronautical, and marine), as well as for long-distance point-to-point radio navigation and various special services. In the microwave range, above 1 GHz, the strict necessity of line-of-sight transmission reduces the possible applications, creating a relative abundance of spectrum for services to which the range is suited and permitting the transmission of complex broadband high-volume data and voice signals.

These characteristics and limitations on the use of the spectrum necessitate international agreements to ensure its efficient and orderly use and development. At the international level, chaos in global communications is avoided by the allocation of frequency bands for particular uses and the co-ordination of specific assignments within these allocations. There are consequential economic advantages, since standardized equipment can easily be mass produced, for both domestic and foreign markets, once a specified band has been allocated. On the other hand, the investment in existing equip-

[4] See Chapter 10.

ment presents a real obstacle to reallocation of frequencies to new uses, which must be well substantiated and cannot be instantly effected.

A principal function of the International Telecommunications Union (ITU)[5] is to co-ordinate the global and regional use of the spectrum. Within Region 2 (North and South America, Greenland, and adjacent waters), Canada has bilateral agreements with the United States, which involve co-ordination procedures in the assignment of frequencies so as to prevent harmful interference. These agreements usually apply within distances from the border that vary with the frequencies and services involved. Canada also has bilateral and multilateral agreements with certain other countries in Region 2 for the co-ordination of frequency assignments. Thus, in general, international constraints may prohibit allocation plans best suited to Canadian needs and, in particular, owing to the high concentration of the population of Canada near the border, the assignment of frequencies in the United States is a fact of life that cannot be brushed aside.

Some of the agreements with the United States go beyond coordination and provide for allocation plans. One example is an agreement that provides for a distribution of television channels to both countries within zones up to 250 miles from the border, which permits orderly development of frequency assignments in accordance with the demand for television service in each country. A Canadian policy objective is to negotiate agreements of this nature for other bands and services in border areas where industrial and urban development is at a high level in either country or both.

Beyond these formal agreements, there is a continuing need for co-ordination wherever there are overlapping areas of international interest in spectrum usage. A case in point is the positioning of geostationary satellites in that part of the equatorial orbit which will serve the whole of North America. In the United States, proposals for domestic satellite-communications systems are a matter for watchful concern in the Canadian interest, for the packing density of satellites in the same orbit is strictly limited if interference is to be avoided. Given the competitive approach sanctioned by the President as a matter of national policy, the demands of the United States for domestic satellite systems are likely to be extensive.

Misunderstanding sometimes arises from a belief that a particular orbital 'position' occupied by a satellite cannot be simultaneously used by another; but, in this context, an orbital 'position' is not a precise location but rather a zone of locations, lying at a specific longitudinal angle to the surface of the earth, in which satellites can be parked in relatively close proximity to one another. For radiocommunication, they can be distinguished from each other by the use of different frequencies. Thus, while attention to

[5] See Chapter 9.

co-ordination is often focused on the distribution of orbital positions, the assignment of radio frequencies for satellite communications is of prime importance, although the orbital position and the characteristics of transmission must also be taken into account as part of the problem of co-ordination. The availability of more frequency bands affords the possibility of multiple use of orbital positions, and a Canadian objective at the next ITU Space Conference will be to make provision for the allocation of additional bands.

The Radio Regulations of the International Telecommunications Union (ITU) provide for a formal notification to that organization when a country intends to establish a communications satellite; notification must be made not earlier than two years and no later than 180 days ahead of the launch. The ITU notification is the first formal step in the co-ordination process, giving the opportunity for any other country to comment. At the next ITU Space Conference, Canada will also propose that the permissible period of notice be extended to three years; this longer period is regarded as more practical in relation to the need for planning, co-ordinating, and implementing systems of this magnitude, especially the desirability of resolving potential problems before committing a particular design to contract. Requirements for the initial Telesat Canada system have been the subject of preliminary co-ordination with the United States and INTELSAT, and formal notification to ITU is now being undertaken.

The radio spectrum is a national as well as an international resource, and a licence to use a particular frequency, whether issued under the authority of the Radio Act or the Broadcasting Act[6], does not convey any property rights. The licensee is entitled to the use of the frequency for only a limited term and accepts certain concomitant obligations. However, some theorists argue that the most effective use of the spectrum, in economic terms, can best be assured by treating it as a marketable commodity, frequencies being assigned to the highest bidder[7]. Among the many weaknesses of a purely economic-value approach to spectrum management, an obvious difficulty is that of the treatment to be accorded to essential services such as defence, emergency measures, air and marine traffic control, law and order, and fire prevention—a list that is by no means exhaustive. Indeed it is evident that the mere definition of 'essential services' presents some difficulty. Nonetheless, a case could perhaps be made for charging the providers of 'essential services' an economic rent for spectrum space, on the ground that, in conditions of excess demand, this would necessitate a close examination of the relative cost-benefit aspects of other means of communication.

6 See Chapter 19 for an outline of the provisions of these Acts.

7 For a detailed theoretical analysis of criteria and methods for measuring the economic value of the spectrum, see Telecommission Study 2(c).

Efficient management of the spectrum is vital to the development of telecommunications systems that will provide access to services for the largest possible number of Canadians at the lowest feasible cost. Its use can be encouraged for such purposes as regional economic expansion and the development of the North, or to assist in the resolution of increasingly complex urban problems. It might possibly become necessary to restrict the use of the spectrum, even in circumstances of temporary abundance of frequencies, to anticipate future congestion that could clearly be foreseen. Spectrum management involves much more than the allocation of frequency-bands and the assignment of particular frequencies. Its foundation rests in long-term planning and the establishment of related technical and performance standards as a basis for regulation in the interest of all users. This is a continuous process which needs to be supported by the monitoring and evaluation of performance to provide the feedback essential for the revision of criteria, standards, and plans.

One of the Telecommission studies[8] was undertaken with the object of assessing the effectiveness of spectrum management in the past, identifying current problems and future needs for frequency usage, determining the effects and optimum applications of technological development, and formulating principles of spectrum management to be followed in the future. The study was entrusted to the Canadian Radio Technical Planning Board (CRTPB), a body established in 1944 which now represents the interests of 22 associations of users, manufacturers, and other organizations directly involved with telecommunications in Canada. The Board was asked to inquire into, and make recommendations upon, all matters bearing on spectrum management in Canada, including the use of the spectrum by radio systems and its 'pollution' by electrical and electronic equipment and devices used for other purposes.

A steering committee, including representatives of some non-member organizations, was established, and the work was assigned to four task forces dealing respectively with broadcasting service; land, air, marine, mobile, and associated fixed services; microwave facilities; and other services. These four task forces made a very detailed approach to the terms of reference, and their reports totalled some 700 pages. Despite broad areas of general agreement, the interests of particular kinds of users of the frequency spectrum are so divergent, or even incompatible, that no unanimity of opinion on many aspects of spectrum management is to be expected. However, of the many observations and recommendations made, there were several of considerable importance which are summarized here.

There seems to be fairly general agreement in the telecommunications industry that no fundamental changes in methods of spectrum management

[8] Telecommission Study 2(h).

(such as the introduction of a market mechanism) are either necessary or desirable. Further, there seems to be a wide measure of agreement on the needs for flexible national planning, for sufficient financial and manpower resources for this purpose, and for regular consultation, on the broadest possible base, with representatives of the spectrum users (or providers of services), the manufacturing industry, and the consumers of services, including the general public.

A recommendation has been put forward by the participants in one study that, in the forward planning of spectrum allocations, there should be wider consultation with the users. But 'the users', in this context, are not the people of Canada but the providers of services, all of whom without exception represent a degree of interest which is often mutually incompatible. In these circumstances, it is a function of the Government (whether through the Department of Communications as at present, or through some other instrumentality) to resolve these incompatibilities in the best interest of the real users of telecommunications—the people of Canada.

A subject of increasing concern in spectrum management is the prevention or control of 'pollution' and interference. Pollution is taken here to mean the type of cumulative or integrated 'noise' from all electrical and electronic sources, which is broadband by nature. Electrical discharges at switch-contacts and over poor insulators generate radio-energy that is not identifiable by frequency but has detrimental effects on the use of the spectrum below about 500 MHz. Sources of electronic pollution include not only heavy industrial machinery but also the concentrated effects of innumerable household appliances and other electrical and electronic devices and equipment. The growth of broadband pollution has been a steady and insidious process. A limited control program was introduced 45 years ago in Canada, but the condition is a matter of increasing concern, particularly in very dense urban areas, and it has been recommended by participants that increased attention should be paid to measures for its prevention or control. Interference between radio transmitters, as distinct from more generalized 'pollution', occasionally causes difficulties, and the growing use of the spectrum necessitates regular revision of allocation plans, assignment criteria, and technical standards. When harmful interference occurs, the remedial measures taken by the Department of Communications involve the cooperation of licensees and, sometimes, of manufacturers.

Most participants in the Telecommission studies of spectrum management agree that, taking a broad view, there is no general shortage of frequency spectrum in Canada at present, or likely to be for the next decade or so. Nevertheless, certain portions of the spectrum are already fairly well filled in some parts of the country, and the problem of sharing terrestrial and space frequencies may grow rapidly in the next decade. In some areas,

all the VHF channels available for broadcasting are already occupied. Some other examples of incipient congestion are the mobile band at 150 MHz, microwave bands around major cities, power-line carrier frequencies in some areas, and maritime bands on the west coast. Some observers believe that the rapid growth of land mobile services will result in acute congestion by about 1980 unless there is some re-allocation.

These conditions reflect much more serious congestion in the same bands in the United States, where some re-allocation to accommodate users is to be expected. At present, if a taxi company in a border city, for instance, requested a frequency for a mobile radio system, its use would be co-ordinated by the Department of Communications with the Federal Communications Commission in the United States so that the system would not experience or cause harmful interference. The difficulty in finding suitable frequencies will increase proportionately with congestion, and it seems particularly important that the Department should be in a position to anticipate possible re-allocations proposed by the United States, to determine precisely their effects on Canadian users, and to put forward counter-proposals necessary for the preservation of Canadian interests. For planning of this kind, which must necessarily be flexible, and which may be defined as optimal exploitation of the inevitable, those responsible for spectrum management must have continuing access to and be able to digest the fullest possible technical, commercial, and economic information and projections.

A typical problem arises from a current proposal in the United States for the sharing of some UHF television channels by the land-mobile service and the broadcasting service. These channels have been allocated to television in the ITU Radio Regulations, and their use for other purposes by any country must not cause interference to the UHF television of another country. For Canada, additional land-mobile frequencies are not yet needed, so the negotiation of a special agreement, which has now been suggested by the United States, presents a difficult problem. It may be typical of others to come in the future as industrial development south of the border has its impact on Canadian spectrum requirements. In the longer run, Canadian land-mobile service frequency requirements may follow the pattern in the United States and, unless the television use of the UHF band is still at a low level in Canada, re-allocation measures may present some difficulty. When services of such a diverse nature compete for the same frequency bands, an exhaustive analysis of the technical, economic, and social implications is needed.

Canada has developed a frequency-allocation table which, while compatible with international agreements, allows in some degree for differing spectrum requirements and equipment standards in various parts of the country. But however congested the spectrum may become in the more

highly populated southern belt, there will always be large parts of the country, not only in the far north, where available frequencies remain abundant. Moreover, congestion is likely to develop in different ways in various parts of the country; for example, re-allocation measures accepted as necessary for the relief of congestion in, say, Windsor/Detroit or Toronto/Buffalo might be quite unnecessarily inconvenient if applied in Montreal, the Maritimes, or the West.

A strong case has accordingly been put forward in favour of continuing to provide for regional variations in spectrum usage. Equipment manufacturers have expressed some reservations on the ground that economies of standardization might be jeopardized, and mobile communications must clearly be compatible from one part of the country to another. Moreover, satellite communications-systems have broad coverage patterns which may become a source of special problems if regional allocation of 'shared' microwave bands were contemplated. Nevertheless, continuing flexibility merits serious consideration as a means to prevent, in Canada, the worst social and economic effects of the congestion already seen to be developing in the United States, where the allocation system is more rigid.

The relief of spectrum congestion by re-allocation of bands is, in essence, a matter of long-term planning. In many cases, it involves taking radio spectrum away from one service, making it available to another service, and allowing for the cost of the adjustment and the time taken for it to become effective. A suggestion that merits consideration is that specific planning periods or cycles should be determined in advance, and an assurance given that no re-allocation will be undertaken within them. If each frequency assignment were related to a planning period of known duration, a spectrum user would have a reasonable assurance of continuity in estimating his costs.

Planning, however skilful, is unlikely to be perfect, and unavoidable expenditures may be incurred by spectrum users when re-allocation is necessitated by unforeseen events. Consideration might perhaps be given to the establishment of an insurance fund to cover the costs, incurred as a result of re-allocation, of enforced re-assignment before the expiry of an agreed planning period. A relatively small annual premium, paid by many thousands of licence holders, would provide a substantial fund within a few years, and the scale of premiums could perhaps be related to the nature of the risk for each licence holder. Two difficulties can be foreseen. In the event of a claim, there might be a dispute as to whether the cause had been predictable or not; and, in many cases, the magnitude of the unforeseen expenditure might be very difficult to determine precisely. Although this proposal for an insurance scheme appears attractive, the administration would be complex and might be so costly as to absorb a disproportionate amount of the premium

revenue. Further, anxiety to minimize payments out of the fund might indirectly tend to inhibit desirable measures of re-allocation.

New technological applications may afford the means to deal with conditions in which the demand exceeds available frequency capacity. The possibilities include the utilization of frequencies in the higher reaches of the spectrum, or more efficient use of those now available. This unexceptionable generalization arouses conflicting opinions about its particularities. When previously unused portions of the spectrum can be utilized as a result of technological developments, there is tremendous flexibility in meeting demands, but changes of this kind are not always predictable. Heavy investment in existing equipment may be a limiting factor in effecting newly developed ways to use a crowded portion of the spectrum more efficiently, such as a reduction of bandwidths for particular purposes.

The feasibility of reduced bandwidth requirements in a particular band is thought by some to have only very limited areas of application, and the concept of 'improved efficiency' in the use of presently available frequencies, in the sense of providing space for more varied use, may entail an unacceptable deterioration of performance. A survey of opinion suggests that, during the next decade, particular attention might be paid to the development of other means of transmission, such as cable and waveguides, so that as much of the spectrum as possible will be reserved, in an ultimate state of maximum usage, for kinds of communications that can employ no alternative.

Licence fees, originally quite nominal, have been gradually increased in recent years, and now cover about half the administrative cost of regulation and spectrum management under the Radio Act. The use of fees, in the sense of charges for resource usage, as a mechanism for promoting or discouraging the use of the spectrum would require a different approach based on estimation of social and economic value. It would not be necessary to attempt a determination of exact value. Fees could be substantial enough to ensure that prospective users examine closely the relative cost benefits of other means of transmission, particularly in conditions of actual or foreseen spectrum congestion. Conversely, fees could be set below the rough market value in circumstances where greater use of the spectrum might appear to be in the public interest.

In the far north, and in the less settled parts of the country, the radio-frequency spectrum might be regarded as a relatively little used resource, which could be exploited in the interests of social development and economic expansion to the limit permitted by its characteristics and the current state of radio technology. A case has been made for an educational and promotional publicity campaign, drawing attention to the real social and economic benefits of spectrum usage. A greater usage could also be positively encouraged by subsidies in cases where the economic benefits are marginal or negative,

but where substantial social benefits can be foreseen, such as the provision of essential services in remote areas. Measures can also be taken to reduce the costs associated with spectrum usage, but the use of sub-standard equipment is acceptable only if interference does not result, and if the user is prepared to accept 'poor quality' communication and the liability to upgrade his equipment if conditions change. Generally, it would have to be recognized that inducements of this kind would be subject to withdrawal when spectrum usage or new services increased to the point of necessitating a re-assessment of the relative social and economic benefit in terms of cost.

During the course of the Telecommission studies, several briefs were received relating to the policy for licensing microwave systems that has been developed by the Department of Communications. Applications for licenses for new microwave systems, whether public or private, have been carefully scrutinized, taking social and economic factors into account, and the estimated construction and operating costs compared with those of obtaining service, to the desired standard, from the telecommunications carriers. The justification for this policy is that both the spectrum and the investment capital available to the industry are potentially scarce resources. Further, there is a need to ensure the economic and operational strength of the established public telecommunication systems if they are to serve Canadians effectively. It is, of course, necessary to exercise a nice degree of judgment with regard to the technical standards of service, for some kinds of users—hydro-electric undertakings, for example—require a quality and continuity of performance that public systems in some parts of Canada may not be able to fulfil.

The planning initiative taken by the Department of Communications regarding microwave systems is not universally acclaimed, and a submission from the Western Canada Telecommunications Council goes so far as to say:

> "The WCTC does not believe the changes now evident under the Department of Communications are in the best interest of the people of Canada."

Some less harsh, but still critical, opinions were expressed in briefs submitted by several hydro undertakings, the Canadian Electrical Association, and the Canadian Association of Broadcasters.

The power utilities observe that microwave systems dedicated to the protection and control of power distribution systems require consideration equal to and separate from that of the microwave systems of the carriers. They believe that the licensing of private utility-owned systems is in the best interests of the public, taking into account all technical, social and economic considerations, and that it is not only compatible with but an integral part of responsible spectrum-management. They recommended that,

to assist the progress of the power industry, restraints on the use of private microwave systems by the power utilities should be strictly limited.

Some broadcasters agree that microwave facilities for national and regional networking should be provided by the telecommunications carriers, but contend that they should have the option of owning their own microwave facilities to meet short-haul requirements. They believe that the policy of the Department of Communications has encouraged the telecommunications carriers to provide private microwave facilities at a cost substantially higher than that of systems which might be built by the broadcasters themselves. While noting that the Department has intervened in certain instances, with the result that charges have been reduced, the broadcasters believe that costs are still sometimes higher than if they provided their own microwave facilities.

The whole subject was thoroughly discussed by participants in the relevant Telecommission study[9], and resulted in a recommendation that:

> "Prior to the adoption of a policy on regulation, licensees or other interested persons should be afforded a reasonable opportunity to make representations where such policies and regulations affected use of the radio spectrum."

The Department of Communications is engaged in the formulation of policy to implement this recommendation by formal consultation procedures, and is giving full weight to the representations made by the power-utilities and the broadcasters.

Subject to the foregoing reservations, most of the participants in the Telecommission study undertaken by the CRTPB (but not all) approved of the methods of spectrum management developed in the past by the Department of Transport, calling for more of the same, but better, from the Department of Communications. Since no general scarcity of spectrum is foreseen during the next decade, except for the developing congestion in particular areas to which attention has been drawn, a gradual refinement of the present system of spectrum management may perhaps continue to satisfy most users and achieve an efficient employment of available resources.

[9] Study 2(h).

CHAPTER 13

Canada East West North South

The exploitation of the radio-frequency spectrum for communications has been one of the most spectacular technological developments of the past 60 years. The effects on society in settled areas are now mostly taken for granted, but there is perhaps less general understanding of the relatively more fundamental benefits that communications can bring to people living in small scattered communities, particularly those beyond the reach of mechanical surface-transportation. But, between the two extremes of the largest city and the isolated community which even has no airstrip there is another spectrum—a progressively inferior scale of access to telecommunications systems and the opportunities and benefits they offer. This inequality, which cannot of course be rectified immediately, and may never be eliminated completely, calls for special consideration and treatment in the formulation and implementation of telecommunications policy.

More than half the population of Canada, and over 70 per cent of the manufacturing labour force, are to be found in the narrow strip, some 700 miles long, between Quebec City and Windsor—an area that is less than 2.5 per cent of the total land mass of Canada. Outside this area, there is a relatively small number of urban concentrations separated by large and sparsely settled tracts, in which the resource-extraction industries are the principal means of livelihood. These regional characteristics give rise to wide differences in average disposable income, and in the business and household demand for different kinds of telecommunications service. For both these factors, the highest rate of growth in recent years has been in the least developed parts of the country, with Newfoundland leading the way. Even so, the telephone density is still twice as high in Ontario as in Newfoundland, and Table 5 gives an idea of the range from one part of the country to another.

Statistics, from the same source, show that the number of calls *per capita* range from 567 in Prince Edward Island to 990 in Manitoba, with an average of 707 for the whole of Canada. Although these figures are related to a slightly different base from those in Table 5, it is possible to deduce other figures that are relevant to regional disparities in access to telecommunications; the average number of calls per telephone in Canada

is 1,618, but the range is from 1,476 in Ontario and Quebec, taken together, to 3,190 in Newfoundland.

Table 5. Telephones per 100 Population[1].

	Total Telephones	Residence Telephones
Ontario	48.5	34.3
British Columbia	46.5	33.2
Alberta	44.0	30.4
CANADA	43.7	30.9
Manitoba	42.7	30.7
Quebec	41.8	29.2
Saskatchewan	37.9	28.2
Yukon Territory	36.8	18.7
Nova Scotia	35.6	25.8
New Brunswick	34.6	24.9
Prince Edward Island	29.4	22.0
Newfoundland	24.6	17.6
Northwest Territories	23.4	13.0

It has been found[2] that there is a remarkable lack of statistics and analyses relating to telecommunications as an element of regional development. Among the factors taken into account in locating industrial plants, the availability of efficient communications is generally taken for granted as being essential, and plans for their provision should therefore be consistent with programs aimed at accelerated regional economic growth and the reduction of economic disparities. What is perhaps even more important is that efficient communications, quite apart from their relevance to business and industry, have come to be taken for granted as an essential amenity of everyday life. Thus, it is not really necessary to enquire whether the provision of efficient telecommunications services will attract industry, because without them industry will have a hard time attracting an efficient labour force. Business and household demand for local telephone service, and business demand for long-distance service, all appear to be[3] independent of price; only

1 DBS—Telephone Statistics, 1969—Catalogue No. 56-203.
2 Telecommission Study 2(d).
3 Telecommission Study 2(b)(i) and (ii), and see Chapter 16.

the household demand for long-distance service shows a substantial sensitivity to the relative price. But, if it be accepted that efficient regional economic growth cannot be accelerated in the absence of efficient communications, it must also be recognized that the resultant increase in disposable income and, eventually, in the educational level of the community will in themselves lead to further increasing demands for new kinds of service—demands which, like that for domestic long-distance service, are relatively price-sensitive.

The regions of slow economic growth are generally those in which resource-based industries are the foundation of the economy, with a low level of development of secondary manufacturing. The operations of the former, lumber and mining for example, are relatively simple and show a correspondingly low rate of demand for communications. Secondary manufacturing, on the other hand, involves a complex production and marketing structure, which requires more intensive use of communications. A change of balance, away from resource extraction towards secondary manufacturing, will necessitate a faster rate of expansion of communications facilities than could be projected from historical growth factors. It follows that an increased rate of capital investment must precede the change if overload is be avoided, for experience shows that, in an overloaded communications network, there is a fairly sharp break-point between gradual decline of service and advanced deterioration.

Regional development programs and planned local growth thus present difficult problems for the telecommunications carriers, for the risk element in the necessary capital investment cannot be extrapolated from past experience, which is generally the basis for consideration of rates of return and tariffs by regulatory bodies. The carriers point out that a rate of return sufficient for the raising of capital on the basis of historical trend is quite likely to be insufficient to meet the needs of accelerated growth.

Another factor to be taken into account, particularly in achieving the social objective of extending access to telecommunications as widely as possible, is that the unit cost of terrestrial distribution bears an inverse relationship to population density—a feature that is apparent for both telephone and broadcasting services. It follows that, if equal service is to be provided, the cost *per capita* will be higher where the population is more widely dispersed and, for that reason, even more essentially dependent on telecommunications than the urban population. This raises the difficult question of the extent to which these additional costs, attributable to the general objectives of social well-being and economic prosperity, should be borne by the direct beneficiaries, by the subscribers to the system, or by the general taxpayer.

The provision of service on demand within a recognized operating territory is usually required by regulatory authorities if it has not been

assumed as a charter obligation by individual telecommunications carriers. Consequently, there is little evidence that the provision of service has been a limiting factor in regional development, except for the most isolated communities, where long-term subsidization might be required. However, an indirectly relevant point is that the socially and economically desirable boundaries of monopoly and competition may differ substantially between urban and rural areas; for some kinds of service well suited to competitive supply where there is a large demand may be more economically provided by a single protected supplier where the demand is small but imperative.

Where plans for regional economic expansion are dependent on the provision of telecommunications services for which there has formerly been an insufficient demand, a certain amount of cross-subsidy between subscribers may be justifiable, on social or general economic grounds, in the public interest. A case has also been made for the provision of assistance from public funds if government policies impose new, and possibly unpredictable, financial burdens and risks on the telecommunications carriers. Financial assistance under the Regional Development Incentives Act can be provided only for manufacturing or processing operations located in designated regions. However the Department of Regional Economic Expansion is more widely empowered to enter into agreements for the establishment, expansion, or modernization of any commercial undertaking in a designated special area, including the guarantee of loans and the payment of grants; these powers have not yet been used to provide assistance for telecommunications systems.

All the factors affecting telecommunications and regional economic expansion apply, in intensified form and with additional features, to the development of the Canadian North. Vast distances, barren terrain, an inhospitable climate, small settlements, native peoples whose cultures and means of livelihood are threatened, different languages, immense mineral resources not yet tapped but hungrily eyed by outsiders—the North has been so often described that a string of *clichés* is unavoidable. The march of so-called civilization has diminished the self-sufficiency of the inhabitants and threatens the natural environment, and at the same time has, paradoxically, intensified the sense of isolation. Here, perhaps to a greater degree than in any other part of Canada, improved communications may be the sovereign remedy.

In the more southerly regions that are underdeveloped, it may be legitimate to assume that accelerated economic growth will automatically, and fairly quickly, improve the lot of the local population. In the North, where economic growth must depend, for the most part, on the extraction of mineral resources, this assumption cannot be supported. When a mine or an oil-well is brought into production, cost factors call for the highest possible degree

of automation, while many of the new employment opportunities require people with skills not commonly found in the North. Often, such employment as may be available for local people can itself be a source of trouble; for, where a community is totally dependent on the operations of a single resource-extraction undertaking, the exhaustion of reserves may be nothing short of disastrous. In the North, as elsewhere, efficient communications are essential to economic growth, but a strong case can be made for assigning first priority to ameliorating social conditions.

Even though, in this context, a new description of northern conditions may not be required, it is necessary to attempt a definition of 'the North' which can be related to common telecommunications problems. The southern boundary of the Yukon and Northwest Territories lies, for the most part, along the 60° parallel of latitude. But the climatic and social characteristics of the North are equally to be found far south of the political boundary between the Territories and the Provinces. The general inadequacy of communications extends southwards to about the 55° parallel, which traverses seven Provinces. It is estimated that about 50,000 people live in the Territories, and another 196,000 in the belt between the 55° and 60° parallels under very similar conditions. Throughout this area men have found it necessary to pool their resources if life is to be tolerable.

The provision of efficient communications in the North affords no exception to the need for a common approach and pooling of resources. Surveys have demonstrated that the public, government agencies, and industry are not even receiving a minimum standard of service in northern areas. About 190 communities or settlements with 50 or more inhabitants have been identified as being in dire need of new or improved services. Some of these have populations up to 500, and a few up to 800. The deficiencies in communications are greatest in the Districts of Franklin and Keewatin, but are also serious in other parts of the Territories and the northern regions of the Provinces.

A particular survey was undertaken by officials of the Department of Communications along the coast of Labrador to obtain a realistic appreciation of essential needs for communications in remote areas. A comprehensive approach was made, relating these needs to all information sources and their interaction. It became evident that, in addition to the primary need for point-to-point communication between scattered communities, there is a largely unsatisfied demand for more information of all types in audible, visual, and legible form. Some of this demand could be met by improved broadcasting coverage (preferably with some local programming), but there are obvious opportunities for the use of videotaped packages, video-cassettes, and other electronic devices to supplement educational methods, libraries, and medical services. If material of this kind could be made sufficiently

available, each community might be provided with playback equipment for use by the entire community.

These findings were reflected at a Conference on Northern Communications[4] which was held at Yellowknife in September, 1970. People who live in the North expressed their need for reliable two-way full-time voice-communication services, and for a broadcasting system that would permit local and educational programming, and provide opportunity for participation in community affairs. The appeal of radio broadcasts is lessened if the language is not understood; live television is welcomed, but is not particularly relevant for someone who is sick, or lost, and in need of assistance.

A symptom of the sense of isolation was the emphasis placed by many participants in the Conference on the need for consultation with local people in determining priorities, not only as between one communications service and another, but also as between communications and other needed facilities —not only broadcasting *versus* telephone, but also telephone *versus* airstrip. In particular, some northern residents questioned the need for the domestic communications-satellite program, which—it was suggested—might pre-empt funds that would otherwise have been available for other communications services and facilities.

In fact, communications satellites are ideally suited to improve services in the Canadian North. Anik is only the first step in the establishment of reliable satellite communications to be made available anywhere in Canada, not only in the North. One of the principal advantages of a satellite communications system is that it is eminently flexible, for a ground-station can be set up anywhere, regardless of distance from existing facilities.

Later satellites is the Telesat family are likely to be more powerful, making it feasible to use less complex and less costly ground installations. Two new types of service of great importance to Canada will then become possible: a telephone and message system using small cheap ground-terminals which can be readily transported and set up anywhere in the country; and a satellite system broadcasting television programs to receivers costing little more than the television set itself. A joint project between the Department of Communications and the United States National Aeronautics & Space Agency (NASA) has, as one of its principal objectives, the establishment by 1974 of the technology for such high-power satellites[5].

Until the advent of the communications satellite, HF radio afforded the only inexpensive means of communicating over great distances, and it is probable that HF radio will continue to be used in the North for many years to come. Troposcatter radio systems are also used in the North for telephone

[4] Sponsored jointly by the Departments of Communications and Indian Affairs & Northern Development; the Governments of the Yukon and Northwest Territories; the Arctic Institute of North America; the Boreal Institute, University of Alberta; and the Centre for Northern Studies, Laval University.

[5] See Chapter 10.

and data-transmission services, and can provide as many as 120 voice channels but cannot carry television programming.

Although Canada has been in the forefront of relevant scientific research and experimentation, northern commercial telephone services using HF radio are plagued by discontinuities caused by both Arctic and solar storms and disturbances. Some improvements may be made through new assignment procedures for radio frequencies, closer monitoring of frequency usage, publication of guidelines and procedures for the HF bands (similar to those for the microwave bands), and making optimum-frequency working maps available. Nonetheless, it is not to be expected that HF radio can ever provide 100-per-cent service in the Canadian North.

Improvements may also be effected through more accurate predictions of radio propagation. A Prediction Service is provided by the Department of Communications, and research directed towards the improvement of predictions and forecasts is making steady progress. The Telecommission study on the North[6] served an additional purpose in establishing new contacts between scientists concerned with the prediction of optimum frequencies for HF services, and representatives of the telecommunications carriers, and in showing the latter how to exploit the potentialities of radio-predictions to improve their services.

There are two large military communications systems in the Canadian North which provide high-quality telephone and data-transmission service, using all the modern technologies, including troposcatter and radio-relay equipment. The DEW Line runs laterally along the Arctic coast, and the Polevault (North) System provides rearward communications to southern Canada; the latter starts at Cape Dyer and proceeds down the east coast of Baffin Island and Labrador to Goose Bay. The DEW Line and Polevault systems could be used more extensively to provide telephone service to communities adjoining or close to the stations of these systems, but for the high cost of renting their long-distance circuits. The wider use of these military systems in the future is a matter for careful consideration.

Public telecommunications services in the North are provided by CNT and Bell Canada. North of latitude 60°, CNT serves the Yukon Territory and that part of the Northwest Territories west of longitude 102°; east of 102°, Bell Canada provides service in the Districts of Franklin and Keewatin. Generally, revenues throughout the area are low, but the area served by CNT is much nearer to becoming economically self-supporting than that served by Bell Canada. Although there is almost infinite room for improvement in service, the carriers in the North have made most praiseworthy efforts to provide at least some kind of service in extremely difficult conditions.

The CBC has also made sustained efforts to improve broadcasting services in the North. Achievements have been limited by the paucity of available funds for new projects, and by the impossibility of providing reliable transmission in the North through short-wave radio facilities. Areas of service have been extended through a number of radio transmitters connected by network

[6] Telecommission Study 8(c)

lines and, in television, through the fairly recent development of a new concept of low-power self-contained television stations known as 'frontier coverage packages', which are fed by a rather restricted taped-program service. The latter will be replaced by a full programming service as satellite distribution facilities become available in the next few years. Meanwhile, however, there are still large unserved regions in the northern parts of the Provinces and in the Territories, particularly the District of Keewatin, the Arctic coast, and Baffin Island. The people in these regions are not insensitive to the fact that, as taxpayers and purchasers of advertised goods, they are helping to pay for broadcasting services that they do not receive.

Improvement and expansion of northern communications will be costly. Communications, like everything else in the North, are more expensive than in other parts of Canada, and it is unlikely that sufficient revenues can be generated to cover their cost, at least in the foreseeable future. A parallel may perhaps be drawn with transportation. Expenditures by the federal Government for air, marine, road, and meteorological services in the far North amounted to $56.7 million in 1969-70, while revenues were only $10.8 million. It is at least arguable that an adequate telecommunications base is essential to support social advancement, economic development, and government administration in the North, and will require a greater impetus than has been given hitherto. A brief by TCTS makes the following point:

> "The telecommunications carriers regard it as essential to the success of any development program for the north that the federal government accept this leadership role in defining the needs and objectives, and take immediate steps to establish the necessary policies. The carriers are ready and willing, now as in the past, to cooperate with the government by providing and operating those telecommunications facilities required to fulfil the broad public policies for the region."

If it be accepted that the federal Government has a responsibility for coordination of telecommunications in the North, it must also be conceded that the people and Governments of the Territories and the northern parts of the Provinces are also vitally concerned in their development. But rights and interests also entail obligations, and it has been pointed out that development programs on a sufficiently ambitious scale would be greatly facilitated by pooling the available financial resources of the governments and telecommunications-carriers concerned. The joint federal/provincial funding of the Trans-Canada Highway offers a possible model for arrangements of this kind.

The adequacy and efficacy of telecommunications services available now and in the future are becoming, to a large extent, determinants of the degree to which the potential human and material resources of Canada can be used to best social and economic effect. For this reason, perhaps, the demand of people in remote places for a voice in the formulation of telecommunications policy represents a challenge to all governments in Canada.

Finally, some suggestions have been made in the course of the Telecommission inquiries that consideration be given to possible forms of organization for an agency to coordinate the planning and implementation of northern telecommunications policies and services[7]. There are obvious constitutional difficulties in devising an organism of this kind, although the thought has been expressed that the corporate structure of Telesat Canada[8] might offer a theoretical model which could be modified to suit the different requirements of northern telecommunications. It has, in particular, been suggested that a body of this kind, starting perhaps with only advisory responsibilities, might evolve in the form of a northern communications-development agency, and that an approach of this nature would seem to merit consultation and consideration by the Governments of Canada, the Provinces, and the Territories.

Whatever the merits of these suggestions—and there are many who consider them premature or impracticable—there is widespread recognition that the improvement of communications in the North, and in other underdeveloped parts of Canada, poses problems that cannot be easily or quickly solved. What is required is a very special combination of perceptive long-range planning and a high degree of dedicated co-operation among all who share responsibility for the development and social well-being of these regions.

[7] At present co-ordination of policy is assigned to a sub-committee of the Advisory Committee on Northern Development.
[8] See Chapter 7.

CHAPTER 14

Aging Switching and Swinging Data

The earliest stage of the transition towards universal-access all-purpose communications is already giving rise to complex economic and technical problems, for interconnection must be dependent on compatibility of systems and equipment. 'Interconnection' is itself an unwieldy term that masks an unstable mixture of social, economic, technical, and political questions subsumed in the concept of a 'right to communicate'. In an ideal world, every new investment in communications plant and equipment would add to an integrated universal system, just as somebody's new driveway potentially connects with the Trans-Canada Highway, the Pennsylvania Turnpike, and the *Avenida Atlantica* in Rio de Janeiro. But the world of telecommunications and computers today is far from ideal. Telegraph systems rarely interconnect with telephone systems, CATV systems are seldom connected with each other and never with the switched distribution networks, and microwave systems with unused capacity remain dedicated and introvert. The problems, essentially, are those of balancing specialized facilities against those best suited to general public services without undue detriment to either.

The largest universe accessible by any subscriber is afforded by the public telephone system. This has been developed with the primary technical objective of optimum voice-communication; it is not ideally suited to many of the new demands that are being placed upon it, and the telephone companies are justifiably concerned to preserve the integrity of the voice-communications system when interconnection problems arise. These considerations are related principally to the use of the switched network, and also have a bearing on the provision of other services by the telephone companies and competitive telecommunications carriers. The technical issues, although weighty in themselves, are often subsidiary to commercial considerations arising from the potential loss of business to the carrier.

Interconnection problems are not entirely new. In the competitive days of the telephone industry, the larger companies in the United States established their dominance by refusing interconnection with independent telephone companies, using arguments very similar to those put forward today. In Canada, however, interconnection between telephone companies is virtually universal, thanks to the development, by mutual agreement, of commonly accepted operating practices and equipment standards. Interconnection with

the systems of established carriers other than telephone companies has been accepted only to a very limited extent.

A new dimension has been added by the rapid expansion, during the last decade, of computerized remote-access information systems, and by the flood of new terminal devices developed by independent manufacturers, using various combinations of transmission speeds, machine languages or codes, and media such as cards or tape. Telephone circuits can accommodate these devices up to certain speeds; higher speeds require independent circuits of greater capacity. The telephone companies argue that one of the chief difficulties in providing data-transmission services through the switched network is that, whereas voice traffic is statistically predictable, data traffic is not; thus, the latter may result in a degradation of voice service by overloading the system—an effect which has already become apparent in certain large cities in the United States. The opposite view is, quite simply, that the telephone companies have failed to provide adequate facilities. Unfortunately, the issues are not as simple as all that. The development of remote multiple-access data-processing services is not only very recent—it is still relatively experimental. Within the computing industry, the debate continues about the future balance of economy between very large computer utilities and mini-computers, probably without sufficient regard to the cost of installing transmission and switching equipment capable of accommodating the former. There is an air of unreality about the picture of an industry accustomed to investing millions of dollars in the development of central processor-equipment and peripheral computing devices which demands, from the telecommunications carriers, services far more exacting than those for which the latter are equipped. Moreover, it is not only the traffic load that is unpredictable—so, to a large extent, is the nature of future demand, for the technology of computers is still in a condition of very rapid change.

It is not surprising, therefore, that the problems of interconnection are seen differently by users of telecommunications services, by equipment manufacturers, and by the telecommunications carriers. Users are increasing rapidly both in numbers and in kind, and generally require access to the switched telephone network; they may include, for certain purposes, telecommunications carriers other than telephone companies. Manufacturers, seeking larger markets for their products, fear that the development of new techniques and equipment may be inhibited by restrictions imposed arbitrarily by the carriers. The carriers see the telecommunications network as a vast dynamic organism with inherent economic and technical inertia which must be taken into account when changes are planned, and which could be degraded or even disrupted by unrestricted access.

The intercommunication practices of telecommunications carriers have been developed from the provisions of their constituting charters, which

generally protect them against any interference with their plant and equipment, and consequently allow them almost complete discretion with regard to interconnection. CN/CPT generally allows interconnection of private systems (other than those leased from the telephone companies) with its network, subject to technical compatibility and the absolute right to disconnect should a degrading factor be introduced, while performance is not guaranteed beyond the point of interconnection. Although the smaller telephone companies tend to be more flexible, the connection of privately owned switching equipment to the telephone network is generally disallowed and, while the private lines of the telephone companies can be interconnected with the public switched network, the private lines of competing carriers are often denied access.

The use of 'foreign' terminal equipment and attachments has increasingly become the subject of controversy between the telephone companies and their customers. In the United States, long-standing rules applied by the American Telephone and Telegraph Company (AT&T) were disrupted in 1968 by a decision of the Federal Communications Commission (FCC), which authorized the use of the 'Carterfone'—an acoustic coupling device which permits a private mobile system to interconnect with the switched telephone network. Although Canadian telephone companies, and Bell Canada in particular, had already developed interconnection practices less rigid than those of AT&T, the outcome of the 'Carterfone' decision removed any doubt about a similar acceptance in Canada of acoustically-coupled devices; other 'foreign' attachments are generally permitted only with protective interface equipment provided by the telephone company. A 1968 amendment to the Bell Canada Act provides a right of appeal to the Canadian Transport Commission as to the 'reasonableness' of the company's interconnection or foreign-attachment requirements, having regard to the public interest, but no case has yet been brought before the Commission.

Industrial users of telecommunications have growing requirements, which foreshadow those of the general public in the future, for faster transfer of information without loss of quality. For these purposes, a great variety of equipment has been developed which may be leased or purchased directly from equipment suppliers other than the carriers, offering the user almost unlimited choice in the selection of the terminal equipment best suited to his particular needs. But unlimited freedom of choice in the selection of telecommunications equipment, without reliable standards of reference, creates difficult problems for users.

The user, in selecting equipment best suited to his needs, may have to accept some compromise if network interconnection is required, but remains highly vulnerable if the equipment has not been provided by the carrier. Limitations may be discovered only after the equipment has been in opera-

tion, and technical improvements or new uses may prove to be incompatible with interconnection practices. Recognizing the legitimate carrier requirements that arise from the responsibility to provide service to the general public, industrial and commercial users see the need for accurate classification standards applying to performance, interfacing requirements, maintenance, and information-transfer capability, and for the certification of equipment, in accordance with these standards, that may be connected to the public telecommunications networks at the user's discretion. Ideally, standards should be applicable throughout the life of the equipment, but a need is seen for authoritative procedures to coordinate changes necessitated by the absolute or relevant obsolescence of user equipment, carrier equipment, or the network system itself. It is also recognized that any significant change in interconnection practices must precisely define responsibility for maintenance of and modifications to user equipment so as to comply with network standards.

It is perhaps dangerous, in attempting to make a balanced presentation of the tensions resulting from these interconnection issues, to employ such generic terms as 'users', 'carriers', and 'manufacturers'. Within each of these groups, there are competitive tensions of equal or greater significance. The attachment of 'foreign' terminal equipment to telephone lines is not a new problem; it is likely to be over-shadowed in the future by that of attaching 'foreign' peripheral computing equipment to the central processor of another make. Computer manufacturers, eager to preserve a captive and growing market for peripheral devices, have themselves tended to move away from interchangability in a way that inhibits interconnections between their own products. The economics of the switched telephone network demand that time not being used by one subscriber can be sold to another, and it is therefore obligatory that signalling and channelling parameters be identical. The computing industry is still a very long way from the standardization established by nature for human communicators, and is thus faced with a dilemma that is partly of its own making. The economies of transmission that derive from rigid standardization are incompatible with pressures to diversify computing equipment, whether the latter result from technological change or the preservation of a captive market.

Special considerations apply to the interconnection of private systems, which may be either owned by the user, or leased from one or more telecommunications carriers, or a combination of both. The telecommunication carriers offer, in addition to their public services, private-line services which, in some cases, share the same equipment and terminal facilities as the public system. The carriers are free to compete with one another, but have agreements for mutual support where the facilities of one can supplement those of the other. The private-line circuits provided by the telephone companies

may often be interconnected with the switched telephone network covering the whole country, a privilege which is not generally extended to the private-line services of other carriers. For example, although telephone services provided in certain parts of Canada by the telegraph companies are connected with the general switched telephone network, interconnection is not permitted for the broadband data-transmission service offered by CN/CPT. It is contended by some, but denied by TCTS, that the telephone companies are at an advantage in offering certain service packages, and tend to exploit their monopolistic nation-wide network to inhibit competition.

Two teletype exchange services, known as TWX and Telex, are offered in Canada respectively by TCTS and CN/CPT. Telex is designed primarily for message communication—the conveyance of generally unstructured information for personal action or record—for which it is extremely efficient. Data-Telex and TWX are better adapted to modern data-communications needs. Interconnection between the two systems, which is provided for overseas communications by COTC, would require interface equipment at strategic points across Canada for the conversion of codes, speeds, transmission modes, and numbering systems. At present, user-demand for interconnection appears to be slight; although a terminal in the alternative network can be acquired for $45.00 a month, only 1.5 per cent of all TWX and Telex users have done so.

In the United States, following recommendations by the Federal Communications Commission (FCC), negotiations are in progress for the acquisition of TWX services by Western Union from AT&T, with provisions to prevent the latter from re-entering the market in another guise, and the outcome will be of great technical and regulatory interest to Canada. TCTS argues that the two systems serve distinct markets, that interconnection facilities are not generally required and would introduce expensive technical and administrative complications, that single ownership of the two systems would not lessen these difficulties, and that the retention of only one service would require abandonment of the investment in the discontinued service and additional unnecessary investment in the other; in short, TCTS recommends that the TWX and Telex offerings of the two carriers should not be interconnected or combined.

The argument put forward by CN/CPT (in a general paper on carrier-to-carrier interconnection) is that competition in private-line offerings is inhibited not only by the size of the public switched telephone network but also by the denial to CN/CPT of access to local switched distribution. The remedy proposed by CN/CPT is that there should be a continuing monopoly in public telephone service and a parallel monopoly in public record service. The latter, to be provided by CN/CPT, would include telegram services, line-switched record services (including equivalent quasi-real-time systems) at

terminal transmission speeds up to those which can be economically accommodated by telegraph circuits without resorting to a full voice-bandwidth, and message switched record services involving store-and-forward switching techniques and operating at any speed dictated by current practice and feasibility. Under this proposal, TWX, Telex, Data-Telex, TelTex, etc., would be included in an integrated CN/CPT network. A vital requirement would be that of access to the telephone switched network so as to achieve comprehensive local distribution of service.

In considering the submissions on this subject by the carriers, the most easily distinguishable point is that for every argument put forward by one party, there is a counter-argument at the command of the other. Interconnection, desirable as it may be in contemporary circumstances, may not be the most important issue, for it is already known that none of the existing systems meets the standards of switching performance that will be required for mass data-transmissions. If newer, more effective, systems are to appear in this decade, which seems highly probable, there would be little point in insisting on interconnection arrangements, related only to present-day techniques, since they would undoubtedly be costly and might take several years to effect. The answer to this problem will depend on decisions about the separate development of voice and data communications systems, which are discussed in the next chapter.

Public service organizations responsible for safety services, such as the police, air and marine navigational aids, fire services, and hospitals, require interconnection of their operational circuits with the public switched telephone network, but difficulties and delays are sometimes encountered; it appears that the independent telephone companies are more cooperative in permitting interconnection than the larger carriers. Some power, oil, and gas transportation companies own and operate extensive telecommunication networks for their operational needs, which demand particular standards of reliability and freedom from interruption of service. Very often, for reasons of security, they do not favour interconnection between their operational circuits and the public telephone systems, but some organizations regard the interconnection of their administrative private-line circuits with the public switched telephone system as of vital importance.

The Canadian Electrical Association has drawn attention to the wide difference between restrictive interconnection practices in one part of the country and another, and contends that the established attitudes of the carriers are no longer applicable to organizations that have competent communications-engineering staff of their own. Hotels offer an interesting example of private commercial organizations with a requirement for complex internal communications which must, of necessity, have complete access to the public switched network; with very few exceptions, hotels have no option

but to lease their PBX installations from the local telephone company, and the Hotel Association of Canada alleges discriminatory treatment of its members. In general, there are grounds for supposing that, except for private systems leased entirely from the telephone companies, interconnection with the public switched network is difficult to obtain and is the exception rather than the rule, and that this attitude appears to be governed more by commercial than by technical issues.

This attitude may sometimes be in the public interest, at least in certain cases, because the interconnection of a private system may, by reducing the volume of paying traffic on the switched network, result in an increase in cost to other users, even to the extent of restricting access and thereby depriving some people of their 'right to communicate'. Concentration of attention on technical problems, which are not inherently insoluble, tends to obscure the much more serious commercial issues facing the carriers in this regard; a proliferation of private systems interconnected with the switched network is seen as a threat to the economies of scale on which the rate-structure for public service is based.

For the manufacturers of telecommunications terminal equipment, the interconnection practices of the carriers appear to add one more economic hurdle to the successful marketing of Canadian products. In this context, a terminal may be defined as a point in a telecommunications system where information can enter or leave the system, or where it can be stored for later transmission. Terminals can also be classified as being oriented to people (telephones, typing machines, video devices), oriented to other machines or systems (using only some kind of machine-language), or dedicated to the control, monitoring, and supervision of communications facilities. Absolute distinctions between these classes cannot be drawn, for some terminals can serve more than one function.

The relatively small Canadian market for telecommunication terminals is a handicap to Canadian manufacturers, for users can choose from a wide variety of products standardized by foreign manufacturers. The Electronic Industries Association of Canada points out that the establishment of suitable interconnection standards would afford greater freedom and opportunity for growth in the manufacturing industry, which has already developed a considerable expertise in systems design and conformity to effective standards.

In the application of interconnection policies, the Canadian carriers can assist the manufacturing industry by showing a preference for Canadian products; they have often done so, but continue to show an overriding preference for the use of equipment that they themselves have supplied. For instance, the electrical interconnection of customer-owned radio paging devices with the switched network is not permitted, but similar paging service provided by the carrier can be connected directly with the public

network. Three of the largest Canadian manufacturers of telecommunications equipment have indicated a preference for maintenance of the *status quo*. Northern Electric has development programs geared to meet the predictable needs of the telecommunications carriers, and would oppose unrestricted interconnection on the grounds that both the integrity of the networks and its own modernization plans would be jeopardized. Automatic Electric and Ericsson prefer to deal only with the carriers, on the ground that only an extensive communications system can provide the necessary quality and continuity of maintenance, and that the reputation of the manufacturer may be seriously damaged by inadequate maintenance if equipment is supplied to private users. In assessing the value of these observations, it should not be forgotten that Northern Electric is a wholly-owned subsidiary of Bell Canada; that Automatic Electric is a subsidiary of the General Telephone and Electronics Corporation, which indirectly controls BC Telephone and *Québec-Téléphone;* and that Ericsson's largest customers are the telecommunications carriers.

The telecommunications carriers, for their part, advance powerful technical arguments for complete control of the public networks, including terminal devices and attached equipment. To maintain a high quality of service to all users, they must be able to guard against technical pollution of the network from other signal sources; to prevent the use of systems or procedures by one user that could interfere with others and degrade the service; to ensure the safety of their employees; and to design their networks consistently with the provision of effective maintenance.

The use of terminals and facilities of mixed ownership increases the difficulty of identifying and correcting sources of trouble, while a terminal connected without suitable safeguards could continually interfere with other users on a random basis, making detection difficult or impossible. Experience has persuaded the carriers (but not everybody else) that users cannot be relied upon for proper maintenance or the introduction of necessary modifications, whereas carrier-provided equipment entails responsibility by the carrier for continuing conformity to network standards. In general, TCTS argues that radical change in existing interconnection policies would jeopardize the cost, quality, speed of innovation, and maintenance of the switched public telephone network, the overall integrity of which, and the quality of its service to the public at large, should be regarded as a paramount consideration.

An important question is the influence of interconnection practices on the rate of innovation and the introduction of new technology. Some users complain that the interface requirements of the carriers unnecessarily add to the cost and inhibit the development of user-owned equipment designed for specific needs, that protective devices nominally available are not actually

available in all cases, and that in fast-moving fields, such as computer time-sharing, there is no justification for the insistence of the carriers on provision of a carrier-controlled interface.

Manufacturers and suppliers of services are concerned that the presence of carrier-owned interface equipment may impede innovation in interconnected equipment. They question the ability of the carriers to respond sufficiently quickly to new requirements; they also argue that the requisite protective devices give the carriers an unfair competitive advantage by adding to the cost of user-owned systems, costs which indeed cannot even be calculated for a new device until the carrier has designed and costed the requisite interface buffer.

It is by no means irrelevant, however, to recall that the computer industry has been moving through new generations of systems at five-year intervals. The incompatibility of one computer with another, or one peripheral device with another, was not an issue of operational consequence until fairly recently—nor, indeed, was much attention given to programming compatibility between one generation of equipment and the next made by a single manufacturer. The dynamic nature of developing computer technology must be reconciled with the requirement, in the public interest, for continuity of traditional telecommunications services.

The carriers, for their part, contend that widespread interconnection will impede innovation in the network, for desirable technological changes might engender strong opposition if they rendered obsolete user-owned equipment representing a large capital investment. A conclusion that can be drawn from all these arguments is that a relaxation of interconnection practices may lead to changes in the relative rate of innovation by users, manufacturers, and carriers respectively, but that the general economic incentive for innovation is likely to provide a balance that is in the public interest.

The interconnection practices of the Canadian telecommunications carriers are, to some extent, derived from those of their counterparts in the United States, and many aspects of networking problems are equally applicable in both countries. Account can therefore usefully be taken of the conclusions reached in a report on this subject which was prepared by the National Academy of Sciences for the FCC. The principal conclusions of that report, which was prepared by a special panel of experienced persons selected by the Computer Science and Engineering Board of the National Academy, are that:

(a) uncontrolled interconnection can cause harm to personnel, network performance, and property;

(b) the (present) . . . criteria . . . relating to signal amplitude, wave form, and spectrum are technically based and valid and, if exceeded, can cause harm by interfering with service to other users;
(c) present . . . criteria together with carrier-provided connecting arrangements are an acceptable basis for assuring protection;
(d) present . . . criteria together with a properly authorized and enforced program of standards development, equipment certification, and controlled installation and maintenance are an acceptable basis for achieving direct user interconnection;
(e) innovation by carriers need not be significantly impeded by a certification program; opportunities for innovation by users would be increased;
(f) mechanisms are needed to promote the exchange of information among carriers, users, and suppliers.

Rather similar conclusions have been reached by some of the participants in the Telecommission studies on this subject. There was general agreement that few interconnection problems would remain if objectives and policies were established for such matters as the permissible amount of competition between carrier suppliers, the economics of developing and introducing Canadian rather than foreign products, and the extent to which Canadian telecommunications capability is to be developed by other than the existing carriers. Clearly, this is a formidable requirement. In particular, however, there was acceptance of the need for standards that would reflect the technical and economic requirements of users, manufacturers, and carriers in due relation to the public interest; these standards should, it was suggested, be established, certified, and monitored by a Canadian organism armed with the necessary authority.

This agreeable concept calls to mind an old story about the inventor who sought financial reward for his wartime revelation that submarines could not survive in boiling water; when asked how the Atlantic was to be boiled, he replied "I've given you the big idea—it's up to you to work out the details." The problem of establishing an organism with any comprehensive federal authority is dealt with in Chapter 19, but it seems clear that a vigorous initiative in the establishment of interconnection standards and other matters is desirable, wherever the authority for their implementation may rest.

The objective of an integrated national network of telecommunications systems, affording comprehensive services that will best serve Canadians and the Canadian economy, will be hard to achieve without some compromise between the interests of users, manufacturers, and carriers with regard to interconnection practices. There seems to be no insurmountable obstacle to the development of a technical certification program that would take account of federal and provincial interests, given a willingness to collaborate in improving the flexibility and common usefulness of all Canadian telecommunications systems. It has been suggested that such a program might

be developed by the federal Department of Communications in consultation with its provincial counterparts and, once standards have been established, disputes about their application could then be referred to the appropriate federal or provincial regulatory body for decision. Under such an arrangement, the onus would be on the carrier to show that interconnection of a technically approved system or terminal device would be, in any particular case, detrimental to the economic base of the rate-structure for public service.

CHAPTER 15

The Marriage of Computers and Communications

The outstanding technological achievement of the past decade, the conquest of space, overshadows the development of digital computer applications that made it possible. Computers are already indispensable tools of scientific research, government, business, and industry, but as yet they have had little direct impact on the man in the street except when they make mistakes. But many observers predict that the computer age is only in its infancy. The development of time-sharing techniques[1] has led to a rapidly growing demand for remote access to computer services, a demand that is already beginning to strain existing telecommunications facilities. Some computer experts forecast that the marriage of computers and communications systems, if it can be successsfully consummated, may generate, within the next few decades, social changes more profound than those of the past 200 years.

Telecommunications systems designed primarily for the transmission of information in any form, making the contents of databanks and the processing power of computers commonly and readily available, may open the way to new dimensions of knowledge, not only in business and industry but equally in the home and at school. Moreover, the interactive two-way capabilities of such systems suggest the possibility of much wider participation by individuals in politics, community affairs, broadcasting, and the arts. Eventually, for those who can afford it, the standard telephone may incorporate video-screen, keyboard, and print-out equipment, giving instant access to all available information and, by simulating face-to-face communication, reduce the need for personal movement and transportation.

It may be useful, especially for those who dismiss these forecasts as visionary, to give a brief account of what is technically feasible today. First, computers have already been developed to a point where human capability for logical thought has been vastly accelerated and extended, while time-sharing techniques have made direct dialogue between man and machine economically practical in some applications. Second, the interaction between a computer and many remote users can be effectively instantaneous, given the proper connections. Third, any information, public or private, can be electronically stored and processed in almost any conceivable way, and can be made available simultaneously to everybody who has access to suitable

[1] See Chapter 2.

terminal and transmission equipment, with reasonable protection against unauthorized access. In short, it is now technically feasible to provide the full power of a large-scale computer-complex to anyone in the world who is served by efficient telecommunications facilities.

The social and economic benefits to be expected from a computer-utility network are predicated on an assumption of virtually universal access, one aspect of which has given rise to the concept of 'The Wired City'[2] The title is perhaps misleading, for the idea is not restricted in its application to cities alone, and the connections are likely to take other forms than wires. The name may in itself give rise to as many misunderstandings as that of the Holy Roman Empire, which Voltaire described as:

> *"Ce corps . . . qui s'appelle encore le saint empire romain n'était en aucune manière ni saint, ni romain, ni empire."*

The hope, indeed the expectation, is that the benefits of the so-called 'Wired City' may gradually be extended to all Canadians, wherever they work and live. High-capacity coaxial-cable and microwave systems have created a revolution in transmission, and another revolution is to be expected from the development, to the point of economic practicability, of local and long-distance transmission systems employing millimetre waves, waveguides, and lasers. The communications-satellite modifies the traditional relationship between cost and distance of transmission, for a two-station system costs much the same whether it serves points two miles or two thousand miles apart, and an eventual convergence of local and long-distance costs is conceivable.

Universal access to telecommunications requires, in contemporary terms, much more than telephones and CATV connections, for the services that a computer-utility can provide through sophisticated terminal equipment extend far beyond those to which people have become accustomed. The technical problems are on the way to being solved, but multi-service systems will be extremely costly, and the demand, particularly for household and personal services, is at present unpredictable. Also, the heavy capital investment in existing systems cannot be instantly written off. Thus the vision of universal access is unlikely to be realized until the late 1980's, if even then, but it will never be realized at all unless it is recognized as a desirable ultimate objective for plans that are being made now.

Many lists have been made of the new services that may become available through the agency of an information-oriented computer/communications network. In some of these lists, the imagination of the authors challenges credulity, for some of the services they suggest appear, at first glance, to be either inherently unattractive or prohibitively expensive, or

[2] See Telecommission Studies 6(d) and 8(d).

both. But such flights of imagination should not be allowed to deflect attention from more practical forecasts. For government, business, industry, and the professions, obvious benefits can be foreseen in the improved effectiveness and economy of operation that result from access to a broader base of information, which can be better organized and processed in any desired way by computer/communications systems. But improved effectiveness and economy of operation can also be provided in the home, through readier access to business and general information and the simplification and compressed storage of personal records and accounts. Remote access computers are already in experimental use by some school systems, and the spread of computer-assisted instruction in schools, although still some years away, could radically affect the whole process of education. There are knowledgable sceptics, however, who observe that computer/communications applications have not so far fulfilled the promise of the early 60's, and who doubt the economic feasibility of implementing the distant prospects sketched in by the enthusiasts.

In fact, a fairly wide variety of data-processing services is already being offered on a remote-access basis to business, industry, and the professions; examples, in addition to information storage and retrieval, are payroll preparation, inventory and process control, on-line banking, accounting and cost control, and billing and payment services. Other current applications include airline, railway, and hotel reservation services; order tallying; stock market quotations; police records; credit reports; and repositories of medical, legal, and scientific information.

For the future, it is significant that few predictions of the availability of new services are related to any precise time-frame; one reason, of course, is that it is a matter of uncertainty as to when a comprehensive information-oriented network might become available. Another is that the installation of sophisticated and sufficiently versatile terminal equipment is still very expensive, and the reduction of costs to a level at which such terminals can be brought into common use will take time; how much time is still a matter for speculation. A third requirement is the ability to forecast the demand for or likelihood of acceptance of new services, a procedure for which effective methods have yet to be devised.

The most immediate developments forecast by technical experts are extensions or refinements of business services already in use or being tried under experimental conditions, and their application to other similar requirements that can be served by the same facilities. A trend is foreseen towards a so-called 'cashless society', when a personal 'money key' might replace most normal cash and cheque transactions if appropriate safeguards can be devised; however, large numbers of Canadians, like Stephen Leacock before them, have not yet become accustomed to using a bank account as a substitute

for cash—a fact that is amply demonstrated in any supermarket on pay-day. Among more personal services, the earliest emphasis is likely to be on information-retrieval television (IRTV) in schools[3] and on-demand pay-as-you-go entertainment in the home, to be followed perhaps by a growing demand for access to educational programming and computer-aided instruction for both children and adults.

Ultimately, as has been said, the existence of a comprehensive all-purpose universal-access telecommunications system may entail profound changes in the day-to-day nature and quality of living experience. Some work now done in offices or schools may come to be done at home, with the side effect of ameliorating urban congestion; it is even possible that, given sufficient transmission capacity, there may be a reversal of the present population trend of movement away from rural to urban areas. There is a real danger, however, in the use of such words as 'ultimately', 'eventually', and 'in the future'. There is little room for complacency, for the shape of things to come will be determined, to a large extent, by actions that are being taken and plans that are being made today. And, so far as Canada is concerned, most of the action and planning for multi-service computer/communications systems has been going on in the United States.

Although Canada has an efficient and sophisticated east-west telecommunications system, the United States lead in the development of large computer utilities could result in a north-south flow of business that would hinder, or even prevent, the establishment of an indigenous computer-utility industry—an industry that may, some experts believe, eventually become one of the largest and most vital in Canada. Already, there are examples of Canadian industrial and commercial information being stored exclusively in databanks in the United States, including vital information about resources[4]; quite apart from the possibly negligible risk of access to this information being denied for political purposes in a time of crisis, there is the real danger of its being used for the exclusive benefit of foreign commercial interests.

The establishment of an exclusively north-south structure for Canadian computer/communications systems might have a number of other serious aspects. First, a concentration in foreign databanks of information about Canadian individuals, transactions, and institutions might render ineffective Canadian laws dealing with such matters as personal privacy and corporate operations. Second, partial storage of Canadian information in the United States, although possibly cheaper in the short run, may jeopardize the

[3] An interesting experiment in IRTV, now nearing completion, has been undertaken in Ottawa during the past two years under the joint sponsorship of Bell Canada, Northern Electric, the Ontario Institute for Studies in Education, and the Ottawa Board of Education.

[4] See Chapter 5.

economic viability of future computer/communications systems in Canada and result in a permanent fragmentation of sources of Canadian information. Third, and perhaps most serious, is the possible effect on the benefits to be expected in Canada from computer-aided methods of education.

A telecommunications network that leads generally to computers and databanks in the United States is likely also to lead to much information and instruction that is not particularly related to Canadian needs; this might perhaps become a matter for much greater concern about the native characteristics of Canadian education than is already aroused by the prevalence of foreign textbooks and teachers. These considerations cannot be dismissed as chauvinism or naive nationalism. The value of Canadian independence lies in the belief that life in Canada has advantages not available elsewhere and, as has been said, it is precisely in the quality of life that computer/communications systems are expected to have the most far-reaching effects—for good or for ill.

The demand for remote access to computer facilities, which heralds the developments under discussion, can be fully met only by the provision of suitable telecommunications systems. Many applications can now be foreseen that will require greater bandwidths than can be provided on normal voice circuits. In addition, overall systems-efficiency could be substantially increased by telecommunication facilities capable of transmitting digital signals without changing their format. Traditional rate-structures, based on experience of the normal time taken to connect and communicate by voice, are ill suited to the transmission of data in digital form, for many remote-access computer applications are distinguished by very long holding times, hours rather than minutes, but a low factor of line-utilization. Traffic tends to flow in short rapid bursts, lasting seconds rather than minutes on which existing rates are based, at relatively long intervals; and connections could be made, given suitable carrier equipment, in milliseconds rather than the seconds charged for at present. Users of computer/communications facilities accordingly argue that productivity could be greatly increased if 'time-and-distance' tariffs could be replaced by flat rates for units of information transmitted. The telecommunications carriers are thus faced with problems that go much farther than those of interconnection discussed in the preceding chapter, namely the unpredictability both of data-transmission loading and of new developments in computer technology.

Governments, however, are faced with even more complex problems in the formulation of policy for the development of Canadian computer/communications networks. A tendency has appeared in the United States for data-processing firms to attempt to diversfy into communications functions hitherto reserved for the telecommunications carriers; if this were to be permitted in Canada, serious damage might be done to the economic base

on which public service is provided. The telecommunications carriers would be open to competition of a kind not easily susceptible to regulation, and the preponderance of foreign ownership in the data-processing industry might have serious implications for Canadian ownership of telecommunications systems. A converse circumstance is that some Canadian carriers, notably CN/CPT and *Québec-Téléphone,* are now directly or indirectly offering data-processing services. This latter development raises grave questions that were discussed in a paper[5] tabled in Parliament by the Minister of Communications in June, 1970, and have been further examined in a Telecommission[6] study, but no conclusions have yet been reached by the federal Government.

The problems raised by the entry of telecommunications carriers into public data-processing are, in essence, those of protecting the public against the exercise of monopolistic privilege to take unfair advantage of competitors, which are discussed in Chapter 17. But the issues in this instance, and in Canada particularly, are even more complex, for some analysts are of the opinion that the data-processing and computer-utility industry is unlikely to remain highly competitive, and that economies of scale and other factors will tend to concentrate the market in favour of the largest suppliers. The largest suppliers in Canada are multi-national corporations controlled from the United States, which have already acquired some 80 per cent of the Canadian market. Therefore, it is argued, one way to ensure the development of a Canadian data-processing industry would be to permit the telecommunications carriers to offer computer facilities, which they already have and could extend if sufficient capital could be secured, to purveyors of data-processing services operating on a competitive basis.

There is, however, another school of thought which contends that computer power and its applications cannot be so clearly distinguished that a hard and fast line could be drawn. Therefore, the argument runs, if the carriers are to be in the business at all, they should not be artificially excluded from one part of what might be regarded as an integral operation. If this view were accepted without restriction, competitive purveyors of data-processing services might then be placed at a grave disadvantage, in more ways than one, because of their absolute dependence on the carriers, their competitors, for essential transmission facilities and services. They, in turn, would have to be protected by some measures imposed on the carriers, which might be difficult to make totally effective, requiring absolute separation of financial, technical, and management resources applied to the data-processing and communications segments of the carriers' operations, together with enforceable safeguards against cross-subsidization between

[5] 'Communications Canada: Participation by Telecommunications Carriers in Public Data-Processing'.

[6] Telecommission Study 5(a), (c), (d), (e)—'Policy Considerations with Respect to Computer Utilities'.

services and preferential treatment of customers and suppliers. Effective measures might indeed have to be so restrictive as to destroy the original *rationale* for allowing the carriers into the business in the first place.

The Telecommission studies of Canadian computer/communications systems have revealed the complexity of the problems involved and the bewildering profusion of policy options they entail. Above all, the studies convey a sense of the need for urgency in the determination of objectives and the formulation of plans in circumstances of rapid change which could easily get out of hand. Accordingly, on 27 November 1970, the Minister of Communications announced the formation of a special task force to continue the investigation of all these problems in depth, and to make recommendations for technical, financial, and institutional policies to ensure the orderly and efficient growth and development of computer/communications systems in Canada. This task force, which is already at work, is expected to produce a definitive report around the end of 1971.

One of the most difficult problems confronting the Computer/Communications Task Force is to balance the advantages and disadvantages of developing separate voice and data transmission-networks. Several countries—Britain, Sweden, and the Federal Republic of Germany, for instance—are constructing dedicated digital networks, and in the United States the Federal Communications Commission has indicated its willingness to consider applications from non-carrier organizations for licences to construct and operate such systems in competition with the existing carriers.

A factor that has to be taken into account is that the rapid development of CATV systems represents an area of technical uncertainty with important implications for the future of computer-utilities. Redesigned CATV systems could not only afford viewers a much wider choice of programs but could also provide a range of new services, many involving two-way communication. Information-retrieval services, for instance, could combine broadband transmission of pictorial material with narrow-band channels, in the same cable, for subscribers' queries and responses to a central computer. So far, however, there is no agreement among experts about the optimum approach to the provision of broadband services, or about the best means of incorporating them into the universal-access computer/communications systems that are envisioned for the future.

Some proponents argue that the full exploitation of broadband distribution systems can be achieved only if they are fully integrated with the switched networks of the telecommunications carriers, who should then be required to meet all demands for service. Others, however, contend that the granting of a broadband-service monopoly to the existing carriers would stifle innovation and retard the development of the very services that offer the greatest social and economic advantages in prospect. They propose, instead,

that new carrier organizations be formed, perhaps through interconnection and amalgamation of existing CATV systems, which could be licensed to compete with the established carriers in providing a limited range of video services.

There appear to be some persuasive technical and short-term economic arguments in favour of promoting the development of a coast-to-coast network of dedicated digital transmission systems. One proposal made by participants in the Telecommission studies is that all publicly accessible remote-access databank and information-processing organizations in Canada should be linked together by a national dedicated digital network to form what the Science Council of Canada has suggested might be called the Trans-Canada Computer Network. Two sub-networks would be involved—one, a circuit-switch system built up from the existing voice network and, possibly, the CATV systems; the other a completely new store-and-forward message-switched system which might share certain trunks and local loops with the first, but would be otherwise independent.

The implementation of a proposal on these lines would require the establishment of a central organization to co-ordinate the integrated operation of the many independent systems and functional components that would be embodied in a Trans-Canada Computer Network. Such a body might be responsible for overall planning, the establishment of common standards, the promotion and co-ordination of related research and development, and possibly for the administration of the subsidies that might be necessary if all Canadians are to be given access to the system so that they can exercise to the full their 'right to communicate'.

The development of comprehensive multi-service computer/communications systems, whatever form they might take, would involve massive capital expenditures. Difficult decisions would be faced in defining the boundaries between monopoly and competitive markets, and in enforcing desirable limits on corporate diversification within the industry. National and international standards would be required for such matters as interconnection of systems and terminal equipment. Should a decision be made to proceed with an undertaking of this kind, it would seem desirable that no Canadian political, social, industrial, or commercial organism capable of contributing resources to the system should be discouraged or prevented from doing so.

It will be noted that, earlier in this Chapter, in describing the benefits from computer/communications integration that are being forecast, virtually all the new applications expected to become available during the next few years are likely to be oriented to business and industry, or to the protection of property. Some cynics would suggest that all the fine-sounding social and personal benefits that are being predicted are no more than pie in the sky and, if developments are to be controlled only by market forces, they may well

prove to be right. To redress the balance, authorities—federal, provincial, and municipal alike—may find it worth while to collaborate in addressing themselves to these problems, so that the greatest possible benefits can be derived from the individual, regional, provincial, and national opportunities that Canadian computer/communications system may be expected to provide, with a significant impact on social, cultural, political, and economic activity.

CHAPTER 16

The Growth Matrix

A feature of the Telecommission studies is that they covered a much wider field than that of the telecommunications industry in its accepted definition. This was necessary for a number of reasons, among them the corporate connections of some telecommunications carriers with manufacturing undertakings. Secondly, the potential capacity of CATV systems to offer other kinds of service not directly related to broadcasting may create a divergence between the Canadian broadcasting system, as defined in the Broadcasting Act, and the standard classification of the broadcasting industry. Thirdly, the growing interdependence of telecommunications and data processing, and the ties between the latter and the computer manufacturing industry, tend to undermine the boundaries long established for purposes of statistical analysis. Thus, in attempting to give an overall view of the present state and growth patterns of these sectors of the economy, there is no single reliable statistical source where all the figures are grouped together, and some inconsistency in statistical bases is unavoidable.

The Telephone and Telegraph Sectors

In 1969, the combined annual revenues of the telecommunications carriers in Canada amounted to some $1.5 billion; their total investment in plant and equipment was more than $6 billion; and together they employed over 75,000 persons, who earned an aggregate of $537 million in wages and salaries.

Some interesting comparisons can be drawn from the breakdown by provinces[1] for the telephone sector (excluding telephone services provided by CN/CPT) in Table 6.

Although the figures in Table 6 relate to provinces, they reveal some interesting variations in the relationships (see Table 7) between cost of plant, revenue, and expenditure, which may—at least to some extent—reflect the investment and depreciation policies of the principal operating companies in each province.

[1] DBS—Telephone Statistics 1969—Catalogue No. 56-203.

Table 6. Telephones, Plant, Revenue, and Expenditure, by Provinces

		($ million)		
	Telephones (nearest 000)	Gross Cost of Plant	Gross Revenues	Expenditures
Newfoundland	127	55.4	14.0	12.8
Prince Edward Island	32	16.8	3.6	3.1
Nova Scotia	273	172.3	38.8	33.6
New Brunswick	216	159.6	35.7	31.1
Quebec/Ontario*	6,179	3,837.1	921.5	800.0
Manitoba	418	278.6	54.3	52.3
Saskatchewan	359	263.3	54.7	43.9
Alberta	696	532.1	121.7	110.0
British Columbia	983	673.0	160.2	140.6

* Also includes Bell Canada operations in Newfoundland and the Northwest Territories.

Table 7. Gross Cost of Plant, Revenue, and Expenditure, per Telephone

	(nearest dollar)					
	Gross Cost of Plant	Revenue	Operating Cost	Interest	Taxes	Balance as % of Gross Cost of Plant
Alberta	765	175	122	32	5	2.19
New Brunswick	739	165	106	13	25	2.82
Saskatchewan	731	152	97	24	2	4.11
British Columbia	685	163	103	15	25	2.92
Manitoba	666	130	96	27	3	0.72
CANADA	645	151	95	16	21	2.95
Nova Scotia	632	142	88	11	24	3.03
Quebec/Ontario	621	149	91	13	25	3.17
Prince Edward Island	525	112	72	10	17	2.68
Newfoundland	436	110	81	15	5	2.08

Obviously, figures of this kind put together from the statistical returns of several companies need to be viewed with caution. They indicate very

marked regional differences in past investment policies which may hinder the development of efficient telecommunications services to which all Canadians can have reasonable access on an equitable basis. They may also serve as a warning that there is a danger in drawing inferences about particularities from the generalizations in which it is necessary to speak of the past growth and future prospects of the telecommunications industry in Canada.

During the past two decades the telecommunications sector has been growing more rapidly than the economy as a whole, and the demand for telecommunications services, as measured by operating revenues, has grown at an average annual rate of nine per cent, or almost double that of GNP. But the growth of demand for different types of service has been far from uniform. Over the period 1950 to 1968, the average rate of growth was 9.8 per cent in the telephone sector, and 8.1 per cent in the telegraph sector.

In the telephone sector, the most rapid growth has been in long-distance telephone and other toll services, and broadband and private lines. For Bell Canada, the 'other toll' component of revenue, which includes a large volume of data transmission, has been growing at an average annual rate of 25 per cent from 1952 to 1967. The relatively lower overall growth rate in the telegraph and cable sector results primarily from the constant decline in revenues from public telegraph-message service, which decreased from a peak of $32.9 million in 1953 to $12.1 million in 1968[2]. This decline has been more than offset by steadily increasing demand for private-line and other services; for example, CN/CP revenues from Telex and broadband services increased at an average annual rate of 27.2 per cent between 1958 and 1967.

It may be of some interest, before proceeding to growth projections, to look at some recent figures (Table 8) for construction expenditures by leading Canadian telecommunications carriers.

Three Telecommunication studies[4] were addressed to market projections in the telecommunications sector, which will be identified in this Chapter as Dobell, Bakony, and the Carriers, respectively. In each of them, different statistical methods were used, so that direct comparisons cannot easily be made.

---

2 The reasons for this decline were examined, together with policy proposals, in a paper—'A Review of the Public Message Telegraph Service in Canada'—tabled in Parliament on 23 June 1970.

4 — DOBELL: Telecommission Report 2(b)(i), 'Communications in Canada: A Statistical Summary'—Institute for the Quantitative Analysis of Social and Economic Policy, University of Toronto (Professor A.R. Dobell);
— BAKONY: Telecommission Report 2(b)(ii), 'Household Demand for Telecommunication Services: A Projection to 1980'—Professor L. I. Bakony, University of Victoria.
— CARRIERS: Telecommission Report 2(e), 'Telecommunications Carriers: Market Projection and Analysis'—TCTS and CN/CPT.

Table 8. Construction Expenditures—Telephone Association of Canada and Canadian National/Canadian Pacific Telecommunications [3]

	Construction Expenditures ($ million)		Percentage Increase (Decrease)	
	1968	1969	Average Past 10 Years	1968/1969
Bell Canada	338.6	389.3	7.1	15.0
B.C. Telephone	70.8	74.0	6.1	4.5
Alberta Gov't Tel.	57.7	69.7	8.9	20.8
Manitoba Tel. System	28.6	32.0	10.6	11.9
CN/CPT	19.4	23.8	1.1	22.7
Sask Tel	22.6	22.9	10.5	1.2
Maritime T&T	19.2	17.7	11.4	(7.4)
New Brunswick Tel.	14.6	17.2	11.2	17.9
Québec-Téléphone	15.9	12.8	11.5	(19.7)
'edmonton telephones'	7.9	11.9	13.7	50.4
N'fld Telephone	6.7	6.5	11.4	(2.9)
Northern Telephone*	5.3	4.9	9.4	(8.2)
Island Telephone	1.7	1.8	11.6	7.0
Ontario Northland	0.3	1.0	1.4	217.5

The telecommunications carriers themselves expect no dramatic changes in needs and services up to about 1975; the period is expected to be one of experimentation and innovation, paving the way for significant changes later. They predict a declining percentage rate of growth in numbers of telephones, although absolute growth will continue to increase. For the period 1975-90, the Carriers estimate that the revenues arising from the normal rate of growth of existing services may be increased, by as much as 50 per cent, by demands for new services that cannot yet be defined except in generic and conceptual terms; in this connection, they stress that "regulatory policy must take into consideration, as an important element, what the industry will be expected to accomplish in the national interest and what earnings will be required to do so, as well as considering the impact of current rates."

[3] Sources—TCTS and CN/CPT.
* Including Northern Quebec Telephone.

The Carriers include forecasts of the number of telephones and messages. They project revenues in current dollars without indicating specifically what rates of price increase are assumed, although they say that they are projecting past rates of price increase into the future. Dobell and Bakony, using historical relationships for the period 1950-67 which take account of the influence of increases in population and income, changes in relative prices, and other factors, project sales (or purchases by households in Bakony) in constant '1967 dollars' for the various types of service. Dobell then uses the constant-dollar sales projections, along with an analysis of production relationships, to project investment and employment.

Dobell summarized his analysis of the demand for telecommunications services thus:

> "The demand for telephone installations is strongly affected by per capita income as well as by demographic factors, and rising incomes will lead to continuing increases in the number of telephones (including extensions) per 100 households.
>
> The demand for telecommunications services (excluding broadcasting) is not sensitive to (that is, is inelastic with respect to) price, except for household long distance calling. (The demand for broadcasting services, being a purchased input into production activities, might be expected to be more sensitive to price, but we have been unable to detect such sensitivity.)
>
> The demand for telecommunications services displays substantial income elasticities in the long-run.
>
> In the short run, the demand for telecommunications services is characterized by substantial inertia and relatively strong habituation, and is insensitive to cyclical swings. The long-run impact of income changes is thus generally much greater than the short run.
>
> The demand for telephone service (and presumably also telegraph service) is homogeneous across regions once differences in income, population, and price have been taken into account.
>
> Demands for the fastest growing (data transmission) services begin from a sufficiently low base that they are unlikely to overwhelm conventional telecommunications services within a decade, even though extremely high present growth rates are observed."

Using these results, Dobell projects future demand by assuming:

— that population will grow at 1.7 per cent per annum;

— that the real growth of GNP will average 5.5 per cent annually to 1975, and 5.0 per cent from then to 1980; and

— that, relative to the price of other goods and services, the price of local telephone service will decline at an average annual rate of 1.0 per cent, and that of long-distance service at 3.0 per cent, giving a weighted average of 1.9 per cent for all telephone services.

Table 9, showing actual and projected revenues for the telecommunications sector, sets out Dobell's results, which are in '1967 dollars', along with those of the Carriers, which are in 'current dollars of each year'. The fact that one set of projections includes price changes and the other does not should not, however, be a serious factor, because the actual level of prices for telecommunications services is assumed to increase only slightly. Over the period to 1975, the overall rates of increase in the revenues of the sector are projected, in both studies, at a rate that averages 8.5 per cent per annum, that is to say slightly below the 9.0 per cent annual growth rate of the last two decades.

Table 9. Telecommunications Carriers—Total Revenues

	($ million)					
	Telephone		Telegraph		TOTAL	
	Dobell	Carriers	Dobell	Carriers	Dobell	Carriers
1940	—	—	—	—	—	83
1955	—	—	—	—	—	446
1960	—	628	—	59	—	687
1965	—	948	—	86	—	1,034
1967	1,164	—	104	—	1,268	—
1968	—	1,268	—	117	—	1,385
1970	—	1,540	—	140	—	1,680
1975	2,261	2,250	191	210	2,452	2,460
1980	3,110	—	268	—	3,378	4,000
1990	—	—	—	—	—	9,500

The figures given by both the Carriers and Dobell suggest that the revenues of the telephone sector will continue to account for about 91 to 92 per cent of the total revenues of the telecommunications carriers. In the telegraph sector, even allowing for a continuing decline in the demand for public telegraph-message service, both studies project a rapid rate of growth; Professor Dobell sees this as a somewhat slower rate than the telephone sector, but the Carriers suggest that both will grow at about the same rate.

For the period 1975-80, the two sets of projections diverge considerably. The Carriers give additional weight to new services, whereas Dobell does not. Further, Dobell assumes a drop in the annual growth-rate of GNP from 5.5 per cent in 1967-75 to 5.0 per cent in 1975-80. Thus the Carriers

project, for the latter period, an annual growth rate of 10 per cent for the telecommunications sector, in comparison with a rate of 6.6 per cent projected by Dobell. Dobell also provides the results of an analysis of the telephone industry using an even more pessimistic set of assumptions—GNP growing at average annual rates of 4.5 per cent and 4.0 per cent for the two periods respectively, and the relative price of telephone services declining at 0.9 per cent instead of 1.9 per cent per annum. On this basis, the annual growth rate for telephone services over the whole period 1967-80 is reduced from 7.9 to 7.0 per cent.

The above results from the market projection studies give a feeling for some of the important factors influencing growth-rates in the telecommunications sector. In general, it can be concluded that the total revenues of the telecommunications carriers may perhaps be expected to double during the next decade.

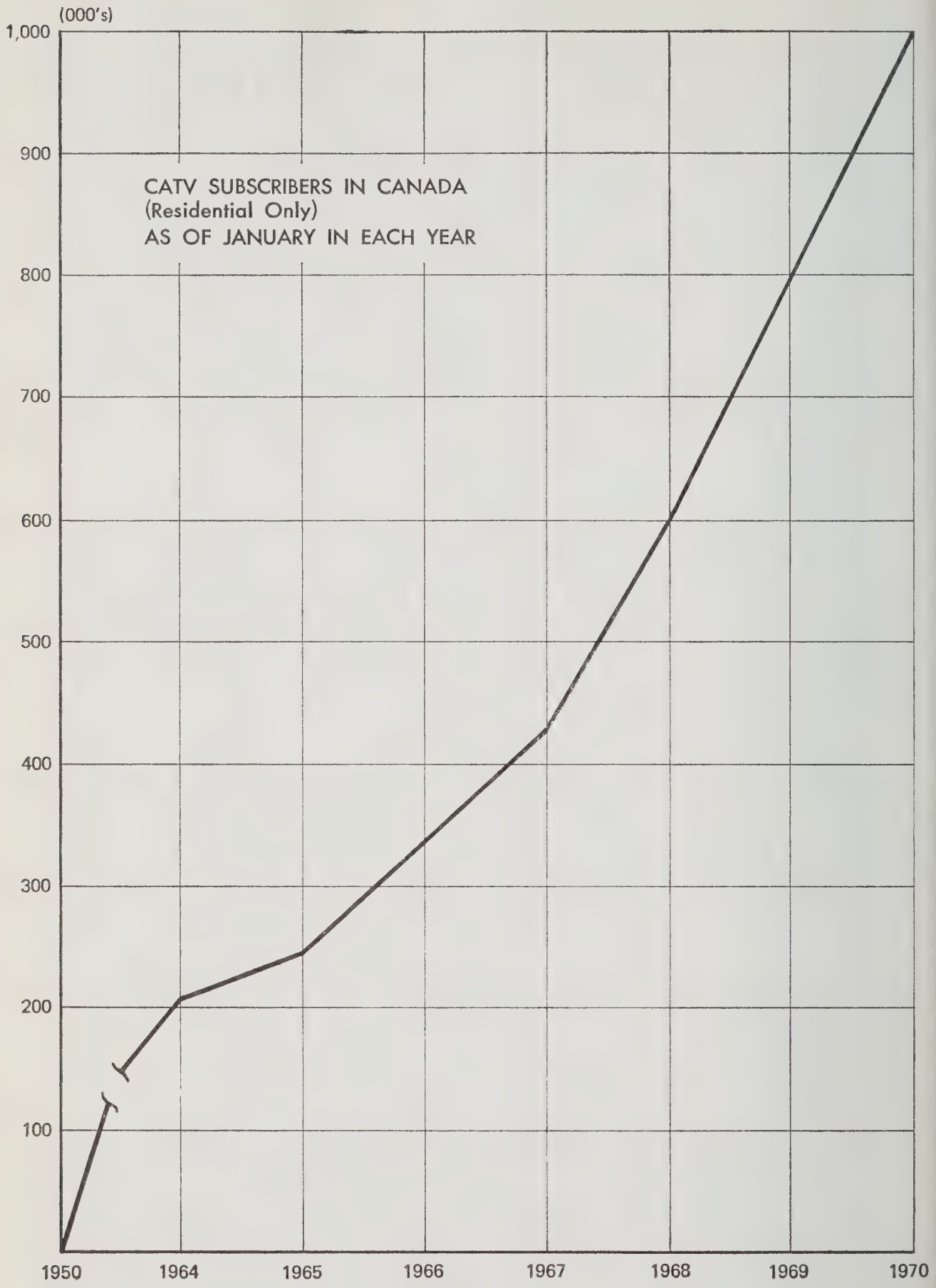
The Broadcasting Industry

The projections that have been described so far apply only to the activities of telephone and telegraph companies. They include the expected revenues from the leasing of transmission facilities to broadcasting undertakings, but not the revenues received by the latter. These amounted to just over $371 million in 1968, including the CBC grant of $146 million. Dobell's projection from this base arrives at a figure of $757 million (measured in '1967 dollars') for 1980.

An additional activity not included in any of the above estimates is the mushroom-growth of CATV systems, which is illustrated in the following diagram, and which will have an impact that cannot be statistically predicted. At present, over one million Canadian households (or some 25 per cent of urban households) are connected to CATV systems, which have gross annual revenues of around $60 million. It is reasonable to anticipate that eventually perhaps two-thirds of urban homes will be connected, and that growth revenues may reach a level of $200 million a year or more, without allowing for other services that redesigned CATV systems might be able to provide.

The Data-Processing Industry

The main uncertainty in projecting the demand for telecommunications services is the volume of demand for data transmission, or 'machine-to-machine' communication, that will be required and the revenue it will generate for the carriers. A substantial rate of increase in data-transmission volume is implicit in the previously-summarized revenue projections of the Carriers. Dobell cites several considerations that will influence the growth of data-transmission requirements, including the usefulness and cost-


(000's)
1,000
900
800
700
600
500
400
300
200
100
CATV SUBSCRIBERS IN CANADA
(Residential Only)
AS OF JANUARY IN EACH YEAR
1950
1964
1965
1966
1967
1968
1969
1970

effectiveness of greater data availability, problems of privacy, file security, and liability for quality standards, and the development of small and low-priced, but relatively powerful, free-standing computers. These last may tend to offset trends to centralized databanks with extensive data-transmission networks to scattered users.

The most that can be said with certainty is that the rate of growth is a matter for speculation. In the past, both economic and technological forecasts have been notoriously unreliable, and developments in Canada are likely to be affected as much by government policy as by anything else. To recapitulate as to the present state of these industries, at the end of 1969 the cumulative depreciated investment in computer systems in Canada was approximately $600 million, and the revenue derived from these systems during 1969 was about $250 million. There is some evidence, which is not entirely conclusive, that the annual rate of growth of computer installations has apparently levelled off at about 20 per cent; if this rate is compounded annually and projected to 1980, it results in a total investment of $5 billion. Another method of assessment is to relate investment to GNP; at present, the gross cumulative investment in computer systems is approximately 0.8 per cent of GNP, and is rising towards the United States figure of a little over one per cent. A projection on this basis leads to an estimated gross investment in the order of $1.8 billion by 1980, but this probably does not make sufficient allowance for the inherent expansiveness of an industry which, according to most authorities, is still in its infancy.

Another approach has been developed in a study[5] (referred to hereafter as Richardson) specially commissioned by the Department of Communications, which takes into account both present and some probable future data-processing applications. Using projections based on 'transaction-population' estimates, Richardson arrives at a minimum total investment figure of $2.3 billion for 1980 if growth is allowed to depend solely on normal market forces. He points out, however, that at present there is little incentive for the telecommunications carriers to develop transaction-oriented networks, because in many cases they are earning revenue on amortized equipment and demand has not yet reached a volume at which the necessary new investment appears commercially viable. Richardson argues that the size of the natural market for data-processing and information services is related to the activities of people, but that its normal rate of growth is likely to be constrained by the investment of telecommunications carriers in existing facilities. He goes on to calculate that, for comparison with a minimum value for the industry of $2.3 billion in 1980, an estimated value of $6.3 billion would be feasible, given the existence of a national transaction-oriented network designed

[5] 'A Forecast of Developments within the Information Processing Industry in Canada'—Lyman Richardson, President, T-Scan Limited, Toronto.

specifically for use by business and industry. It seems evident that the national transaction-oriented network posited by Richardson will not be in existence in 1980 unless the federal Government takes a hand in its development.

Investment and Employment in the Telecommunications Sector and Associated Activities

Attention can now be turned, with all the foregoing reservations in mind, to the likely effects of these growth-projections for the telecommunications sector on investment and employment within the sector and in other closely related activities, such as the manufacture of telecommunications equipment. Dobell examined these implications in an analysis of historical production relationships, including technological change. He estimates that (in constant '1967 dollars') total annual investment in the telephone sector will increase from $582 million in 1967 to $975 million in 1975, and to $1,184 million in 1980, while for the telegraph sector the figures for the same years will be $28.5 million, $46.3 million and $55.4 million.

The largest category of investment in each industry is expected to continue to be equipment, which may probably account for 70 per cent of the total. Dobell estimates that the total number of employees in the telephone and telegraph sector, which he puts at about 77,000 in 1967, will increase to 90,000 in 1975 and 100,000 in 1980.

Dobell also examines investment in the broadcasting industry (excluding CATV), where the average annual investment from 1962 to 1968 is estimated at $27 million, and an average annual investment of $80 million (in '1967 dollars') is projected for 1980, of which $56 million would be for equipment.

Manufacturing Industries

The growth of the telephone, telegraph, and broadcasting sectors, together with their equipment requirements, will have a significant effect on the manufacturing industries supplying the equipment. In another Telecommission study[6], the telecommunications manufacturing industry has been deemed to include manufacturers of telephone and telegraph equipment (including switching, transmission, and station apparatus for telephone, telegraph, data-network, and line services); radiocommunications equipment; television and radio broadcast and distribution equipment; television and radio receivers; telecommunications wire and cable; and electronic computers and related equipment.

Although some of the larger equipment manufacturers make most of the components they need, the study does not include manufacturers of basic

[6] Telecommission Study 2(g).

electronic and electrical components of equipment not primarily associated with telecommunications. Within this definition of the industry, total shipments amounted to $622.5 million in 1967, of which $113.1 million was accounted for by exports. So far as the future is concerned, industry spokesmen go no further than to suggest that the growth experienced during the 1960's is unlikely to be continued during the 1970's without fairly severe adjustments in the industry itself, and without further special incentive assistance from the Government in certain segments. The continued health of the industry is predicated in great part upon achieving a deeper penetration in the export field, for which—in addition to the existing domestic base—a necessary condition is a research and development program aimed at higher performance, lower costs, and a faster production cycle. The probably rapid evolution of digital communications will also require a large development investment.

Dobell has made a statistical analysis and projection of the prospects for the whole of the communications-equipment and electric wire and cable manufacturing industries; unfortunately this definition differs widely from that quoted above, and Dobell arrives at a figure of $937 million (instead of $622.5 million) for total shipments in 1967. His projections therefore may not apply with equal force to the industry under the more restricted definition. The figures indicate that shipments from the wire and cable sector doubled between 1957 and 1968, and shipments of communications equipment increased by a factor of 2.46; however the total number of employees increased by 90 per cent in the latter sector, but by only 11 per cent in the former. Working from the projections of growth for the telecommunications industry as a whole, which have been described above, and taking account of such factors as changes in plant-scale, it is estimated that by 1980 (in constant dollars) domestic shipments of equipment will have increased to $1,880 million, and of wire and cable products to $688 million —a total of $2,568 million. If these growth-rate factors are applied to the figures for the industry under its more restricted definition, the result is a figure of nearly $1,700 million. On either definition of the manufacturing industry, it is safe to say that these estimates would be very substantially increased by the adoption of a stimulated-growth policy for the computer-utility and data-processing industries.

Summary

To summarize the economic prospects for the Canadian telecommunications and associated industries, it seems clear that a continued rapid rate of growth can be predicted. The effects of increasing disposable income on the demand for telecommunications services are likely to be strong. It is also evident that the direction of growth may be substantially influenced by

government policies, particularly with regard to the development of the computer-utility industry in Canada. In addition, the fact that the telecommunications industry is capital-intensive, with a very large part of investment directed to equipment, implies that the prospects of growth for the manufacturers of equipment will depend largely on the direction and rate of growth in telecommunications services that will result from all these considerations.

However, the average rate of growth in numbers of telephones in Canada, as in the United States, although still rapid appears to be levelling off, and is much lower than in most other countries in the world. The implication is that, with a relatively restricted market at home, the telecommunications-manufacturing industry in Canada must seek increased exports if it is to maintain its growth and hold down costs to the Canadian carriers. If a new surge of growth and employment is to appear, it would probably be in the data-transmission sector.

A final note of caution is perhaps necessary. Many participants in the Telecommission studies have expressed fears that the natural growth of data-processing and information services in Canada may be constrained by the existing plant-investments of the telecommunications carriers. These misgivings should be viewed in relation to many formidable financial and operational issues arising from the demand for switched service in a transaction-oriented network. The switching equipment necessary for service on a relatively short 'transaction' basis, with high calling rates and short holding times, will entail vastly greater expenditures for common control than are normally required for telephony. The issue is primarily one of equilibrium in the use of resources, for the telecommunications and data-processing industries are dynamic and peculiarly susceptible to rapid technological change, the dimensions and direction of which cannot be certainly predicted.

PART V

The Public Interest

So much for the promise and the plans. Attention may now be turned to regulatory problems. Where services are supplied in monopolistic conditions, the interests of the public must be protected. In Canada, the right to give this protection to users of telecommunications services is shared between the Governments of Canada and of the Provinces. The regulatory mechanisms they have established are examined, with some observations on their merits and defects, together with suggestions for improvement that have been put forward by participants in the Telecommission studies.

CHAPTER 17

Customers and Shareholders

Efficient telecommunications have a pervasive impact on social well-being and economic prosperity so important as to demand measures to ensure that services are made available as widely as possible and at the lowest feasible overall cost. Most countries have accordingly chosen to establish state monopolies for the provision of telegraph and telephone services which in the United States and, to a large extent, in Canada are supplied by private enterprise. In these latter circumstances, the public interest calls for a variety of policies for social control, including regulation to ensure that rates are just and reasonable and that services are provided to one and all without unjust discrimination; other considerations extend into such areas of national importance as policy with regard to competition and foreign ownership, which are of increasing significance to the telecommunications industry, and others closely allied to it, in Canada.

As matters now stand, general Canadian policy dealing with monopolies and restrictive trade practices is relevant only to certain aspects of corporate integration and diversification. The Combines Investigation Act provides, in Section 2, that a monopoly offence or a merger offence must relate to "the business of manufacturing, producing, transporting, purchasing, supplying, selling, storing or dealing in articles". It has accordingly been held that the provisions of the Act do not apply to the provision of services, as distinct from 'articles', and that there is no statutory authority for dealing with monopolistic or restrictive practices with regard to most telecommunications services. A proposed revision of the Act is under consideration by the federal Government.

Foreign ownership, also, may have significant effects on purely Canadian interests in and needs for the provision of telecommunications services. It has been shown in Chapter 7 that, in Canada, foreign interests control nearly 12 per cent of the telephone system, some 80 per cent of the data-processing market, and almost the whole of the telecommunications-manufacturing industry except for Northern Electric, its largest single component. The Broadcasting Act requires, under Section 2(b), that "the Canadian broadcasting system should be effectively owned and controlled by Canadians". Certain strict criteria have been prescribed by the Governor in

Council under the authority of Section 22(1)(a)(iii) of the Act, which are now being applied by the CRTC.

A perdurable difficulty in dealing with this problem is that ownership and control are not necessarily synonymous. In a large corporation, where the ownership of shares is very widely spread, mostly in small packages, a holding of much less than 50 per cent may be sufficient to ensure effective control, while in some circumstances the debt structure may be more relevant than the ownership of voting shares. The problems of foreign ownership and control are not, of course, peculiar to the telecommunications industry, and are probably of much less significance generally than in the broadcasting sector. So far as the telecommunications carriers are concerned, no serious difficulties are now being encountered, and the pattern of corporate structure, with predominantly Canadian ownership, is so well established that none can be reasonably expected to develop. In the data-processing sector, there are more grounds for concern, for reasons discussed in Chapter 15. Considerations applying to the telecommunications-manufacturing industry are indistinguishable from those applying to Canadian industry in general, and the subject is not one that can be usefully mooted in the context of this Report.

The production and supply of telecommunications services is influenced by particular economic forces that may, if not regulated, act in ways that are not in the best interests of the public at large. When an industry tends to develop monopolistic characteristics, it is a concern of governments to consider whether this tendency is in the public interest and, if it is, to determine the limits within which the entrepreneur should be protected from competition. One approach to the idea of a 'natural monopoly' is that it occurs in conditions where a single supplier can provide a given volume and quality of service more cheaply than any combination of two or more suppliers. Under these conditions, a monopoly may be in the public interest provided that the supplier, in return for the privileges he may be granted, accepts the complementary obligation to charge rates that are just and reasonable, and to provide service to the public at large without unjust discrimination. Governments consequently have an obligation to protect the public interest by ensuring that the privileges of the supplier are neither eroded nor abused, and that his obligations to the public are satisfactorily fulfilled.

Issues in Regulatory Policy

Quite apart from such matters as the efficient use of the radio-frequency spectrum, which was examined in Chapter 12, there are several other im-

portant issues that are central to the development and performance of the telecommunications industry. These include:

— the pricing of services, and the relationship between prices and costs;
— the conditions under which services might be provided by other than the established carriers;
— the extent of the service-areas in which economic regulation may be in the public interest.

These issues are interrelated, and some of their aspects have been dealt with in earlier chapters. The latter include the licensing of private microwave systems (Ch. 12), subsidization of rates to ensure equitable access (Ch. 13), the problems of interconnection (Ch. 14), the impact of traditional rate-structures on the computer-utility industry (Ch. 15), and the requirement that rates should not be so restricted as to inhibit the growth of a capital-intensive industry (Ch. 16).

There is, above all, a public interest in the extent and nature of the services provided, which should be responsive, as far as possible, to social and technological change. These complex issues present a formidable task for any regulatory body, and it would therefore seem desirable to restrict regulation to those areas where conditions of 'natural monopoly' are inevitable, although the determination of those areas may be affected by some features of corporate integration discussed later in this Chapter. Where a monopoly situation is accepted, the telecommunications carriers should be protected from competition, particularly in the provision of the most lucrative services, which are likely to attract outside entrepreneurs anxious to indulge in what has come to be termed 'cream-skimming', so as to avoid cost increases in public service as a whole. Outside the monopoly area, services provided under competitive conditions may be dependent on access to the facilities of the carriers; in order to allow such services to develop, the establishment of technical standards for interconnection seems clearly desirable, but account may also have to be taken of possible economic effects on the operations of the carriers. The question whether the public interest would be served by allowing competition to develop for various types of services depends largely on whether they could actually be provided more cheaply by new specialized carriers, and on what impact the loss of such services might have on the capacity of the regular carriers to meet all their responsibilities. The resolution of these issues hinges, to a large extent, on a sufficient knowledge of the true cost of providing any particular service.

All regulatory bodies in Canada have, hitherto, followed a utility pricing concept based on a determination of rate schedules applicable to services within the operating territory of a company, which are considered in total

with the object of providing enough revenue to meet the overall needs of the company. Inherent in this approach to rate setting is the assumption that inordinate disparities are averaged out; a 'value-of-service' concept is applied to arrive at rate differentials, although the costs associated with particular services, where known, are not completely overlooked.

Some participants in the Telecommission studies have challenged this concept, arguing that rates should be set, wherever possible, with a full knowledge of the true cost of service. It is argued that, while every rate need not precisely reflect the cost of service, cross-subsidization between classes of service, or between groups of customers in different locations, should be identified. These arguments are based on the view that the regulatory authority rather than the carrier should be in a position to decide whether or not cross-subsidization is in the public interest, and that, in some instances, the element of subsidy might be more appropriately provided from some public source.

'The public interest', in any particular circumstances, might be determined by the regulatory body in relation to statutory policy objectives of a general nature, or to more particular statutory criteria. Some provincial statutes governing the regulation of public utilities prescribe criteria against which the reasonableness of rates must be judged. A regulatory body, in those circumstances, is left with little discretion in determining where the public interest may lie when new situations arise.

On this last point, the carriers have suggested that departures from criteria established in legislation should be permitted in certain circumstances. Under present statutory requirements and procedures, the introduction of new equipment or services may be retarded because any rate that may be established must apply to all customers; if rate testing were permitted in particular areas for new services, the carrier would be in a better position to judge public demand before making the new service generally available. Special situations may also arise, in which a carrier may be offering a service in direct competition with another carrier, possibly under a different jurisdiction. The following observations by the Economic Council of Canada[1] are relevant:

> "The danger that regulation may work more as a brake than as a shock absorber must be constantly guarded against." "In any dynamic economy, new institutions, new industries and new products are constantly springing up, sometimes providing competition in areas previously considered to be the preserve of natural monopolies and therefore subject to fairly close regulation. Unless a continuing look-out is kept for the emergence of new competition, the regulations may prevent the established firms from responding appropriately to this new competition."

[1] 'Interim Report on Competition Policy', July 1969.

An alternative is to empower a regulatory body to exercise its functions for the furtherance of general policy objectives set out in a statute. The case for this approach has been well put by CN/CPT in a submission[2]:

> "To place in perspective the development of our position on a scheme of effective regulation, it is essential to define the purpose and goals of regulation. It is also important to note the pitfalls of these definitions and related principles. Within the Canadian economic environment, competition and regulation have the same fundamental objectives: the efficient allocation of resources and the protection of consumers against exploitation. It is the means of obtaining these ends that are quite different. Competition operates through profit incentives and penalties determined by prices set in the market place. Regulation, however, must influence rates itself, thereby determining both the profit incentives and the penalties. Experience clearly indicates that regulation like competition, falls short of perfection.
>
> It has long been accepted that public utilities, such as telecommunications carriers, in which competition is virtually non-existent or effective only within a segment of their activity, must be regulated by government to protect the public interest. This implies that regulation is merely a substitute for competition to promote the public welfare. However, in the case of telecommunications carriers, regulation should be designed having in mind that in the Canadian context these enterprises are engaged in competitive as well as non-competitive activities. Even within the non-competitive field intermodal competition is present: a telephone call may be a satisfactory substitute for a telegram.
>
> The objectives of regulation are essentially to protect the consumer against inadequate service, unreasonable prices, unjust discrimination and undue preference. However, there are other important objectives. Regulation should insure that new services will keep pace with technological advances when a satisfactory level of demand develops, and that new areas will be served when there is sufficient demand. Regulation must promote effective competition.
>
> An important factor must be kept in mind: viz. regulated carriers have to operate within the framework of a competitive economy. They must obtain capital, labour, and materials in competition with non-regulated industries. Adequate gross revenues are not guaranteed to regulated carriers. Regulation must provide incentives to adopt new methods, improve quality, increase efficiency, cut costs, develop new markets and expand in accordance with consumer demand. In short, regulation being a substitute for competition, it should strive to place the regulated carriers on the same footing as competition places non-regulated industries."

On balance, it would appear that, whatever the criteria adopted, effective regulation of rates in the public interest is difficult without a knowledge of costs that is sufficient to identify, at least as a close approximation, the true cost of any particular service. A difficulty arises, even if standard cost-

[2] Telecommission Study 7(a)(b).

accounting is mandatory, in allocating the proportionate cost of facilities, including both plant and personnel, that are used in common by several different services. The problem is not insoluble, for the carriers themselves must have some idea of these cost separations when proposing rates for different kinds of service; they point out, however, that standard cost-accounting formulas have arbitrary features, and that the requirements of various regulatory bodies may differ despite sincere efforts to achieve a realistic approach.

It should be stressed, nonetheless, that the dangers of 'micro-regulation' are twofold. First, it may entail a volume of administrative cost, both in the company and in the regulatory body, that will in itself cause an increase in the price of service. Second, a regulatory body may be lured by a passion for excessive detail into a position of interfering with legitimate management decisions without accepting any responsibility to the shareholders for the results.

The Functional Elements of Telecommunications Services

In telecommunications, the most widely accepted example of a 'natural monopoly' is the provision of local telephone service, including access to long-distance facilities. But the supplier of local telephone service also had a head start in the provision of other services through exclusive control of local distribution and access. If these other services could be provided competitively by a number of suppliers, each should have equal access to distribution and access facilities. Similarly, while the actual provision of long-distance telephone transmission and interconnection with local service elsewhere is not so clearly distinguishable in itself as a 'natural monopoly', the total cost of telecommunications services can most often be minimized if all kinds of traffic are carried on a single system. However, it may be that some particular service might be rendered more cheaply by means of a dedicated system, even when all costs are taken into account; if so, the effects on the public system and the cost of other services to the general public would have to be carefully examined.

Somebody, therefore, has to decide where the public interest lies in permitting new facilities to be established for services that could be provided by the existing telecommunications carriers. Conversely, the public interest requires that a carrier should not be allowed to exploit his privileged position to inhibit economically justifiable competition in the provision of new services. In the simplest condition of monopoly, where a single service is provided by a single private supplier, it might be thought that the public interest could be fully protected by ensuring that the rate of return on the supplier's investment is comparable to that expected from other under-

takings in which the investor is subject to similar risks. Even in this simplistic model, several difficulties are at once apparent.

First, there must be some assurance that service is being made available to everybody on demand and not restricted to those who can be supplied at the least cost of investment in plant and equipment. Second, if it costs more to provide service for some customers than for others, what is a 'just and reasonable' rate? It may be in the public interest that all customers be charged the same; for the subsidization of some customers by others may be justified on the ground that equitable access to and price of service cannot otherwise be ensured. Third, a reasonable rate of return on investment can be determined only with sufficient knowledge of the cost of providing the service, which may itself be unreasonably inflated by the supplier through inefficient management, unnecessarily high salaries for senior executives, discriminatory or self-interested purchasing practices, or in other ways. Finally, there may be no standard of comparison for the level of investment-risk if the undertaking is *sui generis*.

The reader who has persevered thus far may now be willing to examine one or two slightly more elaborate models. Take, first, a telephone company enjoying what amounts to a monopoly in local service, and fulfilling its public obligations to the letter with regard to standard service. What is a 'just and reasonable' rate to charge for optional extras, such as a pink telephone instrument, for example? If the effort put into marketing an optional extra results in an identifiable profit, should that be taken into account in determining a reasonable rate of return on investment for the undertaking as a whole, or should it be regarded as a bonus reward to the investor arising from management initiative?

Theorists who favour methods of regulation that provide incentives for innovation and imaginative marketing would probably opt for the latter. But, once again, there must be some way of separating out the true cost of the optional extra service, which may depend for its feasibility on facilities necessarily available for standard service; in that case, the marginal extra cost to the supplier is not a fair base for determining either the 'just and reasonable' charge to the customer or the allowable extra profit to the supplier. Here, in perhaps over-simplified form, is the essential difficulty of protecting the public against what may be deemed undesirable cross-subsidization of one service by the users of another—in this case the standard service available to the public at large.

Once again, unfortunately, it is an over-simplification to speak of a 'standard service available to the public at large'. Many of the considerations under discussion must be sorted out in their application to different kinds of service offered to different kinds of customer in different conditions

affecting the cost of service. There are opportunities here for cross-subsidization that may or may not be in the public interest. The problem has been well summarized by an observer of the Canadian scene from the United States[3]:

> "It is a matter of conventional wisdom in the telecommunications industry that residence subscribers are subsidized relative to business subscribers, local exchange relative to long-distance, small relative to large exchanges, and low-density relative to high-density routes. In fact, information is simply not available to prove conclusively the extent—and in some cases the direction—of these subsidies, and even if the data were available it would be difficult to evaluate because there is no explicit government statement that public policy objectives do or do not require that subsidies of one sort or another be made."

The next consideration arises from the fact that rates for services should be 'just and reasonable' for the supplier as well as the customer. In particular, in the telecommunications industry, this means that the rate of return on investment must be of an order that will enable the supplier to attract the new capital necessary for improvement and extension of service. An artificially high rate of return might attract investment on a scale that would afford an inducement for the supplier to undertake capital expenditures on projects that are not strictly necessary for the provision of service to which he is committed, or that anticipate future needs too far in advance. The point here is that the return on and depreciation of this additional investment appear as factors in the total cost of supplying service, that is to say the base over and above which the fair return to the supplier is to be calculated, thus tending to increase the rates charged to the public. The process has cumulative characteristics.

The Canadian telecommunications carriers maintain stoutly that decisions about the pace and scale of capital investment are part of the inviolable prerogatives of management. Nevertheless, in a capital-intensive industry, there are other aspects of the public interest in capital investment beyond the danger of artifically inflated rates for service. One is that the capital resources available to the industry may reasonably be regarded as a scarce national resource that must be efficiently used in the interest of the general public rather than that of the shareholders of the carrier corporation. Another is the danger that facilities may be unnecessarily duplicated in conditions, as in Canada, where no carrier enjoys an exclusive geographical monopoly or franchise. In practice, most regulatory bodies in Canada have power to approve at least new equity-capital issues, while in some provinces capital expenditures exceeding as little as $5,000[4] require prior

[3] Carl E. Beigie—'Selected Policy Issues in Canadian Telecommunications' (address to the Canadian Economics Association, 3 June 1970).

[4] $1,000 in Prince Edward Island.

approval. As for the prerogatives of management, it may be remarked that some have, of necessity, been abandoned already in return for the privilege of protection from competition in the provision of essential public services.

In Canada, each telephone company enjoys, not so much as an inalienable right but rather as a matter of circumstance, complete freedom from competition in the provision of local telephone service, including access to the public switched long-distance network. The latter is owned and operated, in effect, by a consortium of the larger companies, which arranges for the separation of revenues arising from traffic carried by more than two of its members. Rates are regulated by the Canadian Transport Commission (CTC) for Bell Canada, BC Telephone, and one or two small companies; all the other telephone companies are subject to provincial or municipal regulatory authority of one kind or another[5]. All services offered by the companies under federal jurisdiction are subject to regulation, but the circumstances of other companies vary from one province to another.

Some of the services provided by Canadian telephone companies are also offered by telegraph companies; of these CN/CPT is by far the most important, and is subject to federal regulation. The principal examples are switched teleprinter services, broadband data-transmission, private-line services of various kinds, and long-distance transmission for the broadcasting networks. Many of these services are offered on a competitive basis, and the telegraph carriers have developed a long-distance coast-to-coast network in parallel with the telephone system. However, they are handicapped by exclusion from the local distribution and access facilities needed for some kinds of service.

Another factor to be taken into account in the formulation of regulatory policy is the existence of user-owned telecommunications systems. Some users claim to identify a gap between their requirements and the service that the public carriers can provide. In consequence many private systems have been built and brought into operation, particularly by undertakings that have no operational requirement for access to the public switched telephone network. This trend has been accentuated by the flexibility of radiocommunication systems. In some cases, large private systems represent a significant duplication of facilities over particular routes, leaving the public facilities less than fully utilized and therefore more costly to the general public.

A new form of competition in local distribution of telecommunications services may be foreseen in the rapid growth of coaxial-cable systems for the transmission of broadcast and other forms of programming. CATV systems are subject to regulation, as 'broadcasting receiving undertakings', by the Canadian Radio-Television Commission. At present, about 70 per cent

[5] See Chapter 19 for more particulars of the regulatory structure in Canada.

of the cables used by CATV undertakings are leased from the local telephone companies under agreements which, almost without exception, prohibit them from offering other telecommunications services that they might otherwise be able to provide by modifications to their systems.

The Canadian Cable Television Association (CCTA) argues that its members, as holders of broadcasting licences, accept obligations and responsibilities, particularly as regards quality and continuity of service, which they may be prevented from satisfying if they are not in complete control of their own distribution systems. In response, the telephone carriers maintain that it is in the public interest, at least in urban conditions, for all telecommunications distribution and access facilities to be provided by a single entity, so as to eliminate unnecessary multiplication of rights of way, and of transmission and switching systems. A significant point is that the leased distribution facilities for CATV systems, which are subject to federal regulation, are provided in many parts of Canada by telephone companies subject to provincial regulation.

The broadcasters, as distinct from CATV operators, see the roles and responsibilities of the broadcaster and the telecommunications carrier as highly specialized and distinct. At present, almost universally, the broadcasters rely on the telecommunications carriers for the provision of local links between studios and transmitters as well as for network transmission facilities. The broadcasters would prefer to have the option of owning their own local links, pointing out that the routes followed are almost always exclusively used by the broadcasters, who may often be able to utilize their own towers and buildings. Although CN/CPT recognizes that, in certain circumstances and where short distances are involved, this might be the most economical arrangement, the telephone companies are firmly of the opinion that the ownership of equipment by broadcasters should be confined to the broadcast transmitter and its associated studio facilities.

The Canadian Association of Broadcasters generally agrees that national and regional facilities for transmission between broadcasting stations should continue to be provided by the telecommunications carriers. It is argued, however, that costs are at present too high,[6] and that consideration might be given to the formation of 'limited carriers' offering specialized services with the requisite standards of performance.

Experience in the United States indicates the emergence of 'limited carriers' providing special services to particular operational and geographical markets. For example, despite the opposition of the established public carriers, the Federal Communications Commission (FCC) has licensed Microwave Communications Inc. to offer microwave services between St. Louis

[6] See Chapter 12.

and Chicago, with customers providing their own local connections. Further, the Datran Corporation has applied to the FCC for authority to develop a coast-to-coast high-speed data-transmission network.

In Canada, there have not yet been any developments on a similar scale. However, there are already instances, and there are likely to be more, of entrepreneurs who identify special services that are not conveniently served by the existing telecommunications carriers, and proceed to establish facilities to meet the requirement. There are computer-service bureaus, for example, which establish cable or radio links to large customers, including the cost of transmission as an integral part of their offerings. There have been instances in the past of 'carrier's carriers' in Canada, providing only long-haul transmission links, but most if not all of these have now been absorbed by the ordinary carriers. Telesat Canada will, when its facilities become operational, probably in 1973, be partly a 'carrier's carrier' by offering the existing carriers an alternative to terrestrial long-haul transmission systems, but will also offer its facilities directly to any customers wishing to lease one or more complete channels.

In summary, it is clear that the authorities responsible for the effective regulation, in the public interest, of telecommunications services in Canada are faced with problems that would be difficult enough to resolve in the simplest circumstances of one supplier enjoying an exclusive franchise for the provision of all kinds of service in a particular area. These problems, varying in kind and degree from one part of the country to another and yet related to interdependent services to which every Canadian may feel entitled, accumulate into a complexity almost beyond human comprehension. However, some themes emerge from the Telecommission studies which, although not universally accepted, appear significant to many of the participants.

The first is that effective rate-regulation is difficult in the absence of valid cost-separations between different services. Secondly, the responsibility should lie with some public authority, rather than with the providers of services, for deciding where and to what extent cross-subsidization within and between various services is justifiable in the public interest. Thirdly, the need for a fair return on investment implies that rates must be high enough to permit the carrier to attract the new capital necessary for innovation, extension of service, and replacement of obsolete plant and equipment; nonetheless, in a capital-intensive industry with monopolistic characteristics, there is a public interest in the optimum use of capital, which may be regarded as a scarce national resource. Fourthly, the economic base from which the established carriers provide total telecommunications services, at what (it is hoped) is the lowest general cost to the public at large, may be jeopardized if poachers are allowed to intrude and

skim off the most profitable services; the conditions governing new entry into the provision of services are therefore a matter of concern for the regulatory authorities.

There may develop, in certain circumstances, economic considerations in favour of allowing new entrants into the preserves of the established telecommunications carriers. Even if economic arguments can be substantiated, they should always be weighed against the possibly detrimental effects on the quality and cost of service provided by existing public systems. If better or cheaper service can be provided for special purposes, is there a danger that it may inhibit the orderly development of telecommunications by delaying the introduction or improvement of general-purpose systems? Sometimes, the new entry may be justified by exclusively technological considerations, as in the case of Telesat Canada, authorized by Parliament to engage in the activities of a public telecommunications carrier. Finally, the complex fabric of regulatory problems in Canada is shot through with others arising from certain aspects of corporate structure in the telecommunications industry.

The Significance of Corporate Structure

Several regulatory matters raised earlier in this Report require some further examination in the context of corporate structure. The first is the need to ensure that subscribers to one service, particularly the general public service, should not be unreasonably subsidizing the provision of another. The second is the danger that the cost of telecommunications services may be inflated by discriminatory or self-interested purchasing practices. In both cases, the most stringent regulatory procedures may be circumvented unless the regulatory authority has some control over corporate structure. The third is the tendency towards a lateral agglomeration of undertakings enjoying the privileges of local monopoly into much larger corporate complexes which, by their sheer size, become a significant influence on the body politic.

The problems of cross-subsidization between one telecommunications service and another have been dealt with earlier in this Chapter, but other issues are raised if telecommunications carriers diversify into the provision of other kinds of service in which competing suppliers are dependent on the telecommunications carriers for transmission and distribution facilities. One example is the potential entry of the carriers into public data-processing, which has been discussed briefly in Chapter 15. If both telephone and telegraph carriers are permitted to engage in the computer-utility field, they will be competing not only with each other for data-transmission business but also in the market for shared-time data-processing services, while remaining dependent for equipment on the computer manufacturers who

already have a dominant position in that area. Relationships would be complicated indeed.

To take a practical example, the computer manufacturers selling equipment to Bell Canada would be, to some extent, competitors of Northern Electric, customers of Bell for leased wires and other transmission and distribution services, and rivals of Bell as computer-utilities. These relationships in themselves would afford a complex regulatory problem, but there are other issues involved. Perhaps the most important is the need, in the interest of Canadian sovereignty, to ensure the adequacy of east-west communications, which may be jeopardized by the rapidly developing warfare between the multi-national corporate giants spawned in the United States. Canada is only one relatively unimportant segment of the global market for computers and computer-services, which is almost totally captive to United States interests. Against them Canada has only one high card to play—the existence of a telecommunications industry that is largely Canadian-owned and has, in one instance, a corporate tie with a Canadian manufacturing undertaking sufficiently large and diversified to benefit from economies of scale in production, research, and development.

The second principal consideration arising out of corporate structure, which is closely related to the first, is that of diversification by telecommunications carriers into the manufacture and supply of equipment, for an artificial price for that equipment may be profitable in several ways. If it is too high, the additional cost to the carrier will eventually be reflected in higher rates for public service, and in the rate of return on investment. At the same time the profitability of the manufacturing company will be improved. On the other hand, if the carrier is offering optional services in competition with other carriers, its economic viability might be enhanced by the purchase of equipment and supplies from its own manufacturing company at less than their fair market price. Furthermore, if the carrier is a large consumer of telecommunications equipment, providing its manufacturing company with a large protected market, competition and innovation in equipment manufacture may be unnecessarily and undesirably constrained.

Against all these dangers, which may be real or hypothetical in Canada, must be set the fact that the successful operation of modern telecommunications services is dependent on the planning and integration of complete systems. Perhaps more than in any other industry, the alteration of any one mode or component has a direct, and often measurable, effect on all other parts of the system. In practical terms, this means that the innovative cycle of the industry must be integrated as to research and development, product manufacture, market demand, and future market needs. Growth strategy must take cognizance of this phenomenon, generally described as 'systems engineering', because if an outside factor changes the growth or

demand pattern for one component of the system, the cumulative effect can be highly counter-productive.

Since the sale of 'articles' is involved, the relationships of telecommunications carriers with manufacturing undertakings are subject to the Combines Investigation Act. The corporate tie between Bell Canada and Northern Electric is the subject of a current investigation under the Act. Although the nature of complaints or inquiries is published or identified only in unusual circumstances, the Director of Investigation and Research (under the Combines Investigation Act) has reported[7] that:

> "The inquiry is concerned primarily with: (1) the danger that the expansion of its regulated telephone business through the acquisition of other telephone companies may spread the monopoly power of Bell Telephone in non-regulated areas by enlarging the captive market available to Northern Electric, its wholly-owned subsidiary: (2) the danger that the monopoly power of Bell Telephone may spread in the non-regulated area through diversification by Northern Electric or the acquisition of other non-regulated suppliers while Bell Telephone continues to be in a position to provide such suppliers with a captive market; and (3) the danger that the monopoly power of Bell Telephone may spread by the control it is able to exert over the equipment which may be attached to its 'electronic highways'. The inquiry was instituted as a result of the relatively recent acquisition by Bell Telephone of all the important telephone companies in Eastern Canada."

The importance of the relationship between Bell Canada and Northern Electric in the context of telecommunications policy has also been a matter of concern to the CTC. On 1 December 1970, the Railway Transport Committee of the Commission promulgated its judgment on the 1970 application by Bell Canada for revisions of the company's tariffs of rates. In that judgment, the Committee noted its continuing concern with respect to Bell Canada's purchasing and investment policies. On the basis of past reports of Northern Electric earnings, the Committee has been satisfied that, on the average, the rate of return earned by Northern on its Bell business was lower than the rate of return on its non-Bell business. However, the 1968 report shows a reversal of this situation. Bell Canada has been directed to provide the report for 1969 by February 1971, and to report 1970 results by 31 August 1971. If these reports reveal a higher rate of return for Northern Electric on Bell business, the Commission will require full justification from Bell that it could not purchase part or all of its supplies from other suppliers at better prices.

The third principal aspect of corporate structure in the telecommunications industry that may be a matter for public concern is the acquisition by one undertaking of others in the same general line of business. This is a

[7] Annual Report for the year ended 31 March 1968.

normal development under conditions of 'natural monopoly' such as exist, in the opinion of many observers, at the local-service level in the telephone industry. But, although some 1,600 Canadian telephone undertakings enjoy this monopoly status in their own local areas, a single group of companies—the Bell group—provides almost 70 per cent of the telephone service in Canada. The gross revenues of this group are in the same order of magnitude as the fiscal revenues of the four maritime Provinces put together. It has close historical and operating ties with AT&T—a foreign corporation that is the largest in the world, with revenues exceeding those of Canada and Sweden together.

Canada derives substantial benefits from the Service Agreement between Bell Canada and AT&T, including the results of research, investigation, experimentation, and developments in telephony; advice and assistance in engineering, traffic, plant, accounting, and other matters pertaining to the provision of telephone service; and the granting of non-exclusive licences under Canadian patents held by AT&T. In return, Bell Canada (like all component undertakings of the Bell System in the United States) pays AT&T 1 per cent of its local and toll revenues (less uncollectables). Similar services are provided by Bell Canada to other members of the Trans-Canada Telephone System, with the exception of B.C. Telephone, which benefits in the same way by association with GT&E, its grandparent organization in the United States. It may be noted, incidentally, that GT&E and its associated companies throughout the world represent more telephones than there are in the whole of Canada.

The corporate policies of Bell Canada appear to have been marked by a generally high degree of regard for the public interest, and its association with AT&T has clearly been beneficial in making available the results of research and development conducted on a scale far beyond what Canada could itself afford. Moreover, it is Canadian-owned, and may be the only corporate structure in Canada of sufficient size to play in the big league—the multi-national corporations based in the United States which dominate the electronics and computer industries. But the fact remains that, except insofar as its operations are subject to effective regulation, the Bell group is answerable not to the general public but only to its own shareholders; even though 95 per cent of them are at least resident in Canada, their interests may not always be identical with those of Canadians in general.

When this subject was raised in a discussion during the course of the Telecommission studies, a representative of Bell Canada asked: "How big is 'too big'? Who is to decide, and against what criteria?" Only the Delphic Oracle, perhaps, would be presumptuous enough to attempt a reply. Possibly the most important point for consideration is the relationship between corporate size and the capacity to respond to Canadian conditions and

demands—to be, in short, effectively socially accountable. This dimension of social accountability is the essential objective of regulation, so that the public interest may be served, and served well. Effective regulation does not necessarily entail excessive attention to all aspects of a company's activities. What is required is that regulatory authorities should have an enlightened understanding both of telecommunications operations and of the objectives of national policy. Both are equally essential if national, regional, and community needs are to be satisfied responsively, constructively, and economically.

CHAPTER 18

A Layman's Guide to Telecommunications and the Constitution[1]

In the British North America (BNA) Act of 1867, there is only one direct reference to telecommunications as now defined—the use of the word 'telegraphs'. Neither the telephone nor radiocommunication had then been invented. Communications and transportation are analogous in many respects, and the present state of jurisprudence with regard to the former is founded to a large extent on a series of judicial decisions, many of which refer primarily to the latter. Some of the most important of these decisions were pronounced by the Judicial Committee of the Privy Council, which was long the ultimate court of appeal for Commonwealth cases. The responsibility with regard to Canadian cases was transferred to the Supreme Court of Canada in 1949.

Sections 91 and 92 of the BNA Act apportion to the federal Parliament and the provincial legislatures the authority to enact laws in relation to matters coming within prescribed classes. Any question that may arise about the class to which the matter embodied in any particular legislation belongs remains a subject for judicial decision. The apparent intention of the Fathers of Confederation was to provide for a clear division of legislative authority, but the long history of court references and decisions is evidence that the intention was not altogether successfully fulfilled in the drafting of the Act.

Although Section 92 is headed 'Exclusive Powers of Provincial Legislatures', it contains a number of exceptions which, by virtue of Section 91(29), must be added to the exclusive powers assigned to the federal Parliament under Section 91. These exceptions include a specific reference to 'telegraphs' in assigning to the provinces, under sub-section 92(10), legislative authority over:

> Local Works and Undertakings other than such as are of the following Classes:
>
> (a) Lines of Steam or Other Ships, Railways, Canals, Telegraphs, and other Works and Undertakings connecting the Province with any other or others of the Provinces, or extending beyond the Limits of the Province;

[1] The several summarized conclusions in this Chapter are based on Telecommission Report 1(a), which cites relevant judgments.

(b) Lines of Steam Ships between the Province and any British or Foreign Country;

(c) Such works as, although wholly situate within the Province, are before or after their Execution declared by the Parliament of Canada to be for the general Advantage of Canada or for the Advantage of Two or more of the Provinces.

To the layman, as to the Fathers of Confederation presumably, these words seem to be perfectly clear, but this is a delusion. What, for example, was meant by 'works' and 'undertakings', and is any significance to be read into the reference to the former but not the latter in 92(10)(*c*)? It has been held in some judicial pronouncements that these terms must be read disjunctively, but in others they have been accepted as interchangeable. Similarly, the expressions 'connecting the Province with any other' and 'extending beyond the Limits of the Province' have been variously interpreted. The precise nature of the connection that might bring a work or undertaking under federal jurisdiction has never been established.

The declaratory power of the federal Parliament under Section 92(10)(*c*) has been exercised (on 470 occasions) with respect to an extraordinary variety of works and undertakings, the general or interprovincial advantage of which has not, in many cases, been readily apparent. However, it has been ruled that, since it is the declaration itself which excludes 'works' from provincial jurisdiction, there can be no recourse to the courts for the purpose of putting 'the general advantage' to the proof. Other judgments have established that, once a statutory declaration has been made, the federal Parliament acquires an express and exclusive jurisdiction over the designated 'work', and that declarations can be revoked, but only by the Parliament of Canada. In recent years, resort to the declaratory power, which was last exercised in 1961, has not been made in controversial cases.

Interpretations of the relevance of physical connection and common operation to the assignment of constitutional jurisdiction have arisen mostly out of cases dealing with the regulation of railway rates. Generally speaking, it has been held that federal jurisdiction over a railway undertaking is not established by physical connection alone; other features of integration must be apparent. But, while physical connection between two railway systems, the lines of which are vested in different corporate entities, may not be enough to compel their treatment as a single interprovincial work or undertaking, yet if two systems, one operating locally and one interprovincially, use the lines that are part of the interprovincial system, the local system will be regarded as part of an interprovincial work or undertaking on this ground alone.

Physical connection together with other features, such as common operation, may be enough to subject a connecting unit to federal regulatory control, but the bare fact of common operation does not by itself appear to be decisive; what has to be established is that the 'local' unit and the 'through' unit are, in their very nature, interdependent and integrated to a substantial degree in practice.

It has been held, for instance, that a highway is not an interprovincial work or undertaking where it runs to a provincial border and there abuts on a highway of the adjacent province. However, the Board of Transport Commissioners[2] has regarded the physical and operational connection of a feeder pipeline with a trunk line as two of several relevant factors in a decision holding that the sale of a gathering line by an interprovincial pipeline company to be a subsidiary would not make the latter a local work or undertaking. The relevance of these decisions to communications has seldom been directly tested, and the special feature of two-way simultaneous use of interconnecting lines might conceivably affect the issue of cases directly concerned with telecommunications.

Although the facilities for interprovincial and foreign telephone calls require both physical connection of wires and operations coordinated with those of intra-provincial systems, the impact of these arrangements on regulatory jurisdiction has never been tested in the courts. An interesting example of a provincial enactment regarding interconnection, which hypothesizes conjoint jurisdiction, is afforded by the Ontario Telephone Act (RSO, 1960; c. 394) under Section 99; to provide for intercommunication between a federal and a provincial system, either system may file an application with the Ontario Telephone Service Commission and with the Board of Transport Commissioners for Canada (now the Canadian Transport Commission) for an order that connection be made.

Section 92(10)(*a*) of the BNA Act also excludes from provincial jurisdiction works and undertakings extending beyond the limits of the province. Here it seems clear that a work or undertaking falls completely within federal authority if it has some interprovincial extensions in practice, since the jurisdiction refers to the work or undertaking as such and not to its interprovincial features. It has been held[3] that an undertaking cannot be broken down, so as to subject it to different legislative jurisdictions, into separate local and long-distance businesses when in fact the two types of operations are carried on as an integrated undertaking. Unfortunately, neither the degree nor the nature of requisite integration has been clarified by the judicial authorities in any generally applicable sense.

[2] Predecessor of the Canadian Transport Commission.
[3] Toronto v. Bell Telephone Co., (1905) A.C. 52.

A related factor (in addition to physical interconnection or common operation, discussed above) is that of corporate structure. The precedents here suggest that a federal or provincial instrument of incorporation does not *ipso facto* determine the regulatory jurisdiction under which the works and undertakings of the company may fall. Secondly, where distinctly separate activities are undertaken by a single corporation, the integrity of the corporate structure does not appear to be a conclusive factor as regards the jurisdictions under which its activities may fall. Thirdly, the corporate identities of parent and subsidiary companies have not precluded them from being treated as a single entity in deciding questions of regulatory jurisdiction. In practice, corporate objects and powers have a certain relevance, but it seems that the most important consideration, according to the precedents, is the practical degree of integration of various corporate activities (including the corporate organizations themselves if more than one is involved) and their inherent interdependence.

A work or undertaking of a class that is subject to federal jurisdiction remains subject to certain general provincial laws on such matters as taxation or 'property and civil rights'. Conversely, a provincially regulated work or undertaking is subject to federal enactments of a specific nature; for example, a provincially-regulated telephone company is required, under the Radio Act, to obtain a federal licence for radiocommunication facilities. In other words, it has been established that subjects which, in one aspect and for one purpose, fall within section 92 of the BNA Act may, in another aspect and for another purpose, fall within Section 91.

The introductory clause of Section 91 empowers the federal Parliament:

> "... to make Laws for the Peace, Order, and good Government of Canada, in relation to all Matters not coming within the Classes of Subjects by this Act assigned exclusively to the Legislatures of the Provinces..."

Various inferences have been drawn from these words in a long series of judicial pronouncements. Taking the relevant case-law as a whole, it would appear that, under the heading of 'Peace, Order and good Government', the Parliament of Canada is constitutionally empowered to enact legislation in relation to matters which do not fall within the enumerated heads of federal or provincial jurisdiction:

— in the case of national emergency;

— when the matters go beyond local or provincial concern, assume national dimensions, and become the concern of Canada as a whole; and;

— in a limited number of cases where the matters may be regarded as coming within the residue of legislative power.

An important decision made by the Judicial Committee of the Privy Council in 1932[4] sustained the jurisdiction of the federal Parliament over radiocommunication, including transmission, reception, and the right to determine the character, use and location of radio apparatus. It had been argued by the Provinces that the substance of radio broadcasting could be divided into two parts, transmitting and receiving, of which the former would be subject to federal jurisdiction and the latter to provincial jurisdiction under Section 92(13). The Committee decided that exclusive federal jurisdiction could be supported under the 'Peace, Order and good Government' wording in the introductory phrase of Section 91, and also on the ground that broadcasting could be brought within the term 'telegraphs' in Section 92(10)(*a*).

On the particular point about the distinction between transmitting and receiving, the judgment was that broadcasting as a system cannot exist without a transmitter and a receiver, and therefore cannot be divided into two parts each independent of the other; the Committee expressed the opinion that:

> "The undertaking of broadcasting is an undertaking connecting the Province with other Provinces and extending beyond the limits of the Province."

These opinions have been endorsed in more recent cases in the Canadian courts, in which it has been held[5] that a system which distributes television programs from a receiving antenna by cable to subscribers (CATV) is an integral undertaking, the component parts of which cannot be separated one from another, and which consequently falls exclusively under federal jurisdiction.

It is evident, even from this brief and necessarily simplified account of the case-law relating directly or indirectly to telecommunications, that in many particular aspects there can be conflicting or mutually incompatible opinions and interpretations. For instance, the submission on this subject by TCTS contends that a telephone company is either local, or connects one province with another, or has been declared to be for the general advantage of Canada; on these assumptions, TCTS argues that:

—"a provincial legislature has sole jurisdiction[6] to regulate a provincially incorporated telephone company which operates within the Province, notwithstanding the fact that its systems or lines connect at provincial borders with those of other provinces;

4 Judicial Committee of the Privy Council: In re Regulation and Control of Radio Communications in Canada, (1932) A.C. 304.

5 e.g. British Columbia Court of Appeal: Public Utilities Commission v. Victoria Cablevision, (1956) 52 W.W.R. 286.

6 Presumably, TCTS did not wish to ignore here the exclusively federal authority over radiocommunications, including—particularly in this context—microwave links.

—"the federal Parliament has jurisdiction to regulate a telephone company which operates in more than one province, or which has been declared to be for the general advantage of Canada;

—"the federal Parliament has jurisdiction over 'Joint Through Rates' negotiated solely between telephone companies subject to federal jurisdiction, but has no jurisdiction to regulate 'Joint Through Rates' between companies subject to provincial jurisdiction and companies subject to federal jurisdiction."

These statements, it must be stressed, represent the views put forward by TCTS, and quite different opinions and interpretations can be, and have been, derived from the same body of jurisprduence. According to some lawyers, it appears that the following differing conclusions can all be drawn with validity:

— an exclusively federal jurisdiction applies to all telephone companies that provide regular interprovincial service; *or*
— an exclusively federal jurisdiction applies to all telephone companies that form part of the interprovincial network; *or*
— provincial jurisdiction is limited to intraprovincial operations, while all interprovincial communications and agreements are subject to federal jurisdiction; *or*
— regulatory jurisdiction over a telephone company operating within a single province is exclusively provincial, notwithstanding the fact of interconnection, the only exceptions being those cases[7] in which the federal declaratory power has been exercised.

If, as it appears, the BNA Act is imprecise in respect to telephone and telegraph companies, its application to new kinds of telecommunications systems obviously presents even greater difficulties of interpretation. The concept of networking, developed in Chapter 15, encompassing not only the public networks but also private-line facilities and general access to centralized computers and databanks, raises new questions about the possibly extended meaning of the word 'telegraphs' in the BNA Act. The concept is one in which the emphasis is on the integration of function (as distinct from the means of communication) in a sense that may be difficult to align with the definitions of 'works' and 'undertakings' handed down in a hundred years of judicial pronouncements.

The physical characteristics of telecommunications systems are now such as to permit anybody in one province to communicate, at the time and in the mode of his choice, with almost anybody in another province or outside Canada. At any given moment of time, extra-provincial connections

[7] The works and undertakings of Bell Canada and BC Telephone, as well as those of a few smaller companies, have been declared to be 'for the general advantage of Canada' in the statutes under which they are incorporated.

can be and are being made through facilities which, in earlier days, might justifiably have been regarded as meeting purely local needs. Although the facilities themselves may be entirely within a single province, it can hardly be denied that the services provided "connect one Province with another" or "extend beyond the limits of the Province", and that their efficiency is vital to the development, the social and economic prosperity, and the very survival of Canada as a sovereign state.

At the same time, it would be equally hard to deny that the technological revolution in communications that has occurred since the enactment of the constitution of Canada in 1867 has greatly enlarged the value and importance of telecommunications systems in relation to matters that fall, under the BNA Act, within the jurisdiction of the Provinces. The impact of broadcasting on education, for instance, requires no explanation or new emphasis here. The discussions outlined in Chapter 3 demonstrate the opportunities that may soon become available, through new telecommunications facilities, for a much wider participation by the citizenry in politics and, perhaps even more importantly, in local community and group affairs and discussions. The systems that will provide these opportunities will also, if their full potential is to be achieved, provide services that extend beyond the borders of a particular province, a feature that will add to rather than detract from their local importance and value.

The only telecommunications service known to the draftsmen of the BNA Act was the telegraph, by which messages could be tapped out in code on a wire, and the physical limits of the wire could be easily identified. Today, and even more so tomorrow, services are profuse, various, complex, interdependent, and of vital concern to all the people of Canada. In short, federal and provincial interests in telecommunications are complementary rather than conflicting, and afford ample opportunity for constructive co-operation by all governments in Canada.

CHAPTER 19

The Co-operative Structure

The earliest Canadian legislation relating to telecommunication[1] was enacted some years before Confederation. In the Resolutions of the 1864 Quebec Conference on the constitution, 'telegraphs' were included among those matters reserved to the 'general Parliament', and the same line was followed in the London Resolutions of 1866. However, as has been shown, this approach was modified in the BNA Act, and Canadian telecommunications undertakings are severally subject to federal or provincial regulatory jurisdiction.

On the federal scene, the earliest exercise of regulatory authority took the form of provisions embodied in the constituting charters of telephone and telegraph companies, including the railway companies offering public telegraph services. In 1892, for instance, the Bell Charter was amended to prohibit increases in existing rates without the approval of the Governor in Council; another amendment in 1902 authorized the Governor in Council to increase or decrease rates upon the application of the company or of any interested municipality, and also to commission a Judge to undertake a summary inquiry into application and make appropriate recommendations. The charters of Bell and other companies subject to federal jurisdiction were amended in 1906 to bring them within the scope of the Railway Act of 1903, which established a Board of Commissioners with regulatory powers over railway, telegraph, and telephone rates in general. The Board was abolished and its powers under the Railway Act transferred to the Canadian Transport Commission (CTC) by the National Transportation Act of 1967.

The Railway Act, insofar as it relates to telecommunications, applies to railway, telegraph, and telephone companies, within the legislative authority of Parliament, that are authorized or have power to construct or operate a telegraph or telephone system or line, and to charge tolls for its use by the public. The following undertakings offering public message-telegraph and telephone services are subject to regulation by CTC, either because they have been declared, by statute, to be "for the general advantage of Canada", or because they operate in more than one Province:

— Algoma Central Railway[2] (*)

1 Electric Telegraph Companies Act, CSC 1859, c. LXVII.

2 Algoma Central Telephone Company Limited (subject to provincial regulation) is a subsidiary of Northern Telephone Limited; the latter is a subsidiary of Bell Canada.

(*) Telegraph only.

— Bell Canada (**)
— The Bonaventure and Gaspé Telephone Company (**)
(a subsidiary of *Québec-Téléphone*)
— British Columbia Telephone (**)
— Canadian National Telecommunications (***)
— Canadian Pacific Telecommunications (*)
— Nipissing Central Railway (a subsidiary of Ontario Northland Communications) (***)
— Northern Alberta Railways (*) (jointly owned by CNR and CPR)
— Quebec North Shore and Labrador Railway (***).

Before proceeding to an account of the Railway Act and other federal regulatory legislation, it may be helpful to sketch in the main features of arrangements in the Provinces. From about 1906 on, most of the Provinces established Boards or Commissions empowered to regulate the operations and financial arrangements of public utilities, including telecommunications undertakings, that were subject to provincial jurisdiction. Control over Saskatchewan Telecommunications (SaskTel) is exercised by its Government-appointed directors, the Minister of Telephones, and a select Standing Committee of the Legislature; the Minister of Telephones is also empowered to delegate to SaskTel the administration of the Telephone Department Act governing nearly 900 small systems established under the Rural Telephone Act.

In Quebec, where a Public Utilities Commission was first established in 1909, the regulatory function over telecommunications was assigned to a separate board when the Communications Department was established in 1969. The Minister of Communications has the responsibility of formulating and implementing communications policy for the Province and, in particular, is required to supervise the communications networks in the Province and to promote their development and efficiency.

In Newfoundland, Nova Scotia, Alberta, and British Columbia, the 'reasonableness' of rates to be charged by provincially regulated telephone companies is tested by formulas relating the rate of return to a rate base calculated on a valuation of plant in service, plus allowances for such items as working capital. In New Brunswick, Quebec, and Manitoba, rates must be just and reasonable; no tests are specified in the relevant statutes, but in Manitoba there is an enumeration of specific factors which must be taken into consideration. In Prince Edward Island, the test is the rate of return related to a rate base to be fixed by the regulatory authority. The test of rates for rural telephone systems in Saskatchewan is that they be sufficient to pay operating and other approved costs.

(*) Telegraph only.
(**) Telephone only.
(***) Telegraph and telephone.

In Ontario, the rates of the larger telephone systems (other than Bell Canada, which is subject to federal jurisdiction) are related to return on capital investment; for municipal systems, rates must be sufficient to meet payments of principal and interest on debentures. The Ontario Northland Transportation Commission, which provides telephone and telegraph services in the northern central parts of the Province, is self-regulated by its Cabinet-appointed members; tariffs are normally accepted as established by Bell Canada. Through a subsidiary company[3], the Commission owns and operates lines and services extending into the Province of Quebec, which are subject to federal regulation.

Rates for private-line voice service are regulated in Nova Scotia and Prince Edward Island, and for all private services in Quebec and Newfoundland. In most provinces, the respective authorities have power to regulate the quality and availability of the public service offered by undertakings subject to their jurisdiction, and approval is required for construction of new public systems and lines. In Saskatchewan and Newfoundland all projects involving capital expenditures over $25,000 require prior approval; in Nova Scotia the amount has recently been raised to $5,000 from $1,000—a figure which still applies in Prince Edward Island.

There are 26 municipal telephone systems in Canada, which are also variously subject to regulation under provincial statutes governing municipal affairs. Of these, 'edmonton telephones limited' is a member of the Telephone Association of Canada. The only other large municipal system is that in Thunder Bay, Ontario.

Apart from directly relevant legislation, all telecommunications carriers are subject to a number of federal and provincial measures of a general nature. For example crossings of navigable waters are subject to the Navigable Waters Protection Act, crossings of railways under federal jurisdiction must comply with the Railway Act, and crossings of oil and gas pipelines under federal jurisdiction must comply with the National Energy Board Act. Crossings of roads and highways, as well as various similar matters, generally entail dealings with the appropriate provincial and municipal authorities.

This necessarily brief account of the regulatory structure related to telephone and telegraph companies may, like the structure itself, seem far from clear. The reader avid for more detail is advised to consult the relevant Telecommission study reports[4]. It is evident that, at least in the field of telecommunications, the intention of the Fathers of Confederation to establish, in the BNA Act, a clear demarcation between federal and provincial legislative jurisdictions has not been entirely successful.

It may be recalled that Section 92(10) (a) of the BNA Act has been held to bring under federal jurisdiction telecommunications undertakings

[3] Nipissing Central Railway.
[4] Telecommission Studies 1(a), 1(b), 7(a), and 8(a).

extending beyond the limits of a province. However, services in Creighton, Saskatchewan, are provided by the Manitoba Telephone System, and in Lloydminster, Saskatchewan, by Alberta Government Telephones; and yet these two provincial Crown corporations remain subject to provincial regulatory jurisdiction.

Among other curiosities to be seen in various parts of Canada are:

— a federally regulated subsidiary (Bonaventure-Gaspé) of a provincially regulated company (*Québec-Téléphone*);
— provincially regulated subsidiaries of federally regulated companies operating in the same Province (e.g. Okanagan Telephone/B.C. Telephone);
— provincially regulated subsidiaries of federally regulated companies operating in another Province (e.g. Newfoundland Telephone/Bell Canada);
— provincially regulated companies that have subsidiaries regulated by another Province (e.g. Maritime T&T/Island Telephone); and
— a federally regulated subsidiary (Nipissing Central) of a self-regulating provincial Crown corporation (Ontario Northland).

In several Provinces, the number of telecommunications undertakings to be regulated is small. In most cases, the regulatory authority is assigned to a Board or Commission dealing with all kinds of public utilities, a factor that limits the amount of attention that can be given to the operation of the telecommunications companies.

All telephone and telegraph companies of any substantial size make use of radiocommunications in their operations and are, for that purpose, subject to federal regulation under the Radio Act. Early federal interest in radiocommunications was evinced by the Wireless Telegraphy Act of 1905, which was superseded by the Radio Telegraph Act of 1913; this was at first administered by the Department of Naval Services, and later by the Department of Transport. As has been recounted, exclusive federal jurisdiction over radiocommunications was confirmed in a judgment of the Judicial Committee of the Privy Council in 1932. The Radio Act of 1938, which—with subsequent amendments—is still in force, empowered the Minister of Transport to issue licences for radio stations (including, until 1968, broadcasting undertakings) and, generally, to make regulations for the orderly development of radiocommunications, including the establishment of standards for equipment and operations. Responsibility for the administration of the Radio Act was transferred to the Minister of Communications in 1969.

'Radiocommunication' or 'radio' is defined in the Radio Act as:

> any transmission, emission or reception of signs, signals, writing, images, sounds or intelligence of any nature by means of electromagnetic waves of frequencies lower than 3,000 Gigacycles per second propagated in space without artificial guide.

A 'radio station' is defined as "a place where radio apparatus is located", and

> radio apparatus means a reasonably complete and sufficient combination of distinct appliances intended for or capable of being used for radiocommunication.

Radio stations, other than broadcasting undertakings, require a licence, to which the Minister may attach:

> such terms and conditions as he considers appropriate for ensuring the orderly development and operation of radiocommunication in Canada.

Ordinary broadcasting receiving sets are exempt from licensing. The minister may make regulations classifying radio stations; prescribing the type of apparatus that may be installed, the frequency and power, and the nature of services provided; and for the purpose of implementing and making effective the terms of international agreements.

Federal regulation of broadcasting, as a distinct element of radiocommunications[5], dates from the establishment, in 1932, of the Canadian Radio Broadcasting Commission, which was empowered to provide public broadcasting service and, simultaneously, to regulate the operations of private broadcasters. These powers were transferred to a successor organization, the Canadian Broadcasting Corporation (CBC), in 1938 by legislation which continued in force for 20 years. The 1958 Broadcasting Act, which maintained the CBC as an operating agency, transferred the regulatory authority to the Board of Broadcast Governors (BBG). Throughout this period, and indeed until 1968, the authority to issue broadcasting licences was vested in the Minister of Transport on the recommendation of the regulatory authority and with the approval of the Governor in Council. The licensing power was transferred to the Executive Committee of the Canadian Radio-Television Commission (CRTC), the successor to the BBG, by the 1968 Broadcasting Act. However, the Act reserves to the Governor in Council a right to set aside, or refer back to the Commission, the issue, amendment, or renewal of a broadcasting licence (s. 23). The Governor in Council may also give directions to the CRTC regarding the maximum number of channels that may be licensed in a particular area, the reservation of channels for special purposes, and the designation of classes of persons ineligible to hold broadcasting licences (s. 22).

Under the Department of State Act, the Secretary of State has responsibility for broadcasting matters not by law assigned to any other department or agency of the Government of Canada; he is also designated, for the purposes of the Financial Administration Act, as the appropriate Minister for the CRTC and the CBC, and is their spokesman in Parliament. The exercise

[5] Broadcasting is defined in the Radio Act and other statutes as "any radiocommunication in which the transmissions are intended for direct reception by the general public."

of powers by the CRTC is subject not only to the Broadcasting Act, but also to the Radio Act; thus no broadcasting licence may be issued without a technical construction and operating certificate issued by the Minister of Communications, who has complete responsibility for regulating the technical aspects of broadcasting. Subject to the foregoing reservations, the CRTC has authority to:

> regulate and supervise all aspects of the Canadian broadcasting system with a view to implementing the broadcasting policy enunciated in Section 2 (of the Broadcasting Act).

Until 31 March 1968, a community-antenna television (CATV) system required a licence issued by the Minister of Transport under the Radio Act. Originally, however, some urban systems also had to obtain a municipal franchise, and there was uncertainty and growing concern about the means by which their detrimental impact on conventional television stations might be controlled. In 1965, a judgment of the British Columbia Court of Appeal[6] held that CATV systems, including the distribution cables, must be regarded as integral broadcasting receiving undertakings subject to federal regulation alone. In the 1968 Broadcasting Act, broadcasting receiving undertakings were formally recognized as components of the Canadian broadcasting system and, as such, subject to the regulatory authority of the CRTC; like other broadcasting undertakings, of course, there is a requirement for a technical construction and operating certificate to be issued by the Minister of Communications.

The Department of Communications was established by the Government Organization Act, 1969, for the purpose of ensuring the development and efficiency of communications systems and facilities. The Minister is responsible for the administration of the Radio Act, the Telegraphs Act, the Canadian Overseas Telecommunications Act, and the Telesat Canada Act, and is the spokesman in Parliament for the Canadian Transport Commission (CTC) on communications matters.

The Telegraphs Act is in four parts, dealing respectively with the privacy of messages, the construction and operation of telegraph land-lines by undertakings incorporated under the Companies Act (now the Canada Corporations Act), the regulation of inter-provincial submarine cable undertakings, and the regulation of external submarine cable undertakings. A clause in the Railway Act provides that Part II of the Telegraphs Act applies, insofar as it is not inconsistent with the former, to undertakings subject to the jurisdiction of the CTC; the construction and working of telegraph lines is now specifically excluded from the permissible objects and purposes of a company to be incorporated under the Canada Corporations Act. Interprovincial cable undertakings governed by Part III are subject to regulation with

[6] Public Utilities Commission v. Victoria Cablevision, (1956) 52 W.W.R. 286.

regard to rates and some other matters by the CTC, but the Minister of Communications also has authority over certain aspects of construction and operation. The regulatory authority under Part IV is assigned to the Governor in Council and exercised through the Minister of Communications.

The Canadian Transportation Commission (CTC) exercises regulatory authority over telephone and telegraph companies subject to the jurisdiction of Parliament. The powers of the Commission derive not only from the National Transportation Act and the Railway Act but also from the respective charters of incorporation of the undertakings subject to its authority. Its regulatory powers are, in general, designed to permit only the exercise of economic or financial control over a corporate entity; thus, in addition to the regulation of rate-tariffs, capital stock issues must be approved, and the extent and form of accounting and statistical reporting may be prescribed. CTC has only very limited authority, except in some special circumstances, over technical matters, and none whatsoever with regard to the nature and quality of the services offered, except that Bell Canada may be required to furnish service under certain restricted and clearly defined conditions.

The CTC is required, under Section 381 of the Railway Act, to ensure that:

(1) All tolls shall be just and reasonable and shall always under substantially similar circumstances and conditions with respect to all traffic of the same description carried over the same route, be charged equally to all persons at the same rate.

(2) A company shall not in respect of tolls
  (a) make any unjust discrimination against any person or company;
  (b) make or give any undue or unreasonable preference or advantage to or in favour of any particular person or company or any particular description of traffic, in any respect whatever; or
  (c) subject any particular person or company or any particular description of traffic to any undue or unreasonable prejudice or disadvantage, in any respect whatever;

  and where it is shown that the company makes any discrimination or gives any preference or advantage, the burden of proving that the discrimination is not unjust or that the preference is not undue or unreasonable lies upon the company.

In the early days, the 'reasonableness' of rates was related to the earning requirements of the company, but in 1966 a new basis was adopted, which permitted a level of earnings ranging from 6.2 to 6.6 per cent as a reasonable return on total average capitalization. This basis was largely abandoned in 1969, since the principle of regulation based on permissive levels of earnings had been weakened by the proliferation of services offered by the telecommunications carriers, the rate-levels for which did not then require approval. However, under an amendment to the Railway Act, which came

into force on 1 August 1970, all services offered by the federally regulated telecommunications carriers have ben brought within the jurisdiction of the Commission, necessitating the filing of more than 50,000 tariffs for private-line services. In particular, there are some practical problems in dealing with tariffs relating to individual agreements for services in the form of special assemblies.

In 1969, the CTC disallowed an application by Bell Canada for a revision of tariffs for local telephone rates. In a new application in 1970, Bell Canada stressed the need for increases that would provide a sufficient return on equity to attract new capital required for its construction program. The increases applied for would have produced an estimated return of 9.2 per cent on equity and 7.6 per cent on total capitalization in 1971. The Railway Committee of the CTC, in its judgment of 1 December 1970, held that, although there had been marked increases in costs since the previous application, the attraction of capital on reasonable terms would not necessitate results of that order. Bell had asked for an increase of 6.25 per cent in rates for all exchange telephone services; however, the Committee approved an increase of only 3.75 per cent on basic residential and business telephone service, while allowing the requested increase of 6.25 per cent for all other exchange telephone services. It is estimated that these increases will produce a return of 7.5 per cent on total capital in 1971.

Even the most logical theories of regulation are difficult to apply to telecommunications carriers in Canada, which are severally subject to federal or provincial regulatory authority. In particular, the establishment of long-haul telephone charges gives rise to some difficulties. Generally, rates are the same in both directions, even if provincial boundaries are crossed, a circumstance implying that a rate agreed between the two companies concerned has been approved by more than one regulatory body. But difficulties may arise, even within the boundaries of a single province, where local service in two communities at a distance is provided by different companies. A point to bear in mind in this connection is that the toll between two cities in the same province may be a matter of substantial public interest from a provincial angle; but it may have been effectively established, either in one direction or both, on the basis of quite different considerations by a company subject only to federal regulation.

At the present time, long-distance telephone rates are, in effect, the outcome of bilateral or multilateral agreements between carriers under the auspices of the Trans-Canada Telephone System (TCTS) [7]. The separation of the resultant revenues from interprovincial traffic carried by two TCTS members with contiguous territories is settled by bilateral agreement between them. The revenues for traffic carried by more than two TCTS members are

[7] See Chapter 7.

shared in accordance with principles established by TCTS itself. In either of these cases, each member of TCTS is then responsible for making its own arrangements for revenue separation with other telephone companies in the province or region in which it is the predominant operator. Of the total toll revenue collected by the telephone companies, it has been estimated that very roughly 35-40 per cent is related to 'out-of-territory' traffic.

Whether these arrangements are always satisfactory to the 'independent' companies is brought into question by a brief submitted by 'edmonton telephones limited' which suggests that, in its negotiations with Alberta Government Telephones, the latter gives insufficient weight to the contribution of exchange service as an integral part of the national toll network. It is believed that *Québec-Téléphone* is also dissatisfied with the revenue-sharing principles established by TCTS. The facts alleged by 'edmonton telephones limited' are inconsistent with the opinion of many analysts that, generally in Canada, exchange service is being subsidized by toll service, and that this is not conducive to the promotion of east-west communications in Canada. These questions precisely exemplify the kind of problem that is hard to resolve in the public interest in a Canadian context.

Perhaps the aspect of this permissive situation that gives greatest ground for concern is the suggestion, illustrated by Table 10, that long-distance rates in Canada are substantially higher than rates for corresponding distances in the United States. Positive evidence is hard to establish, because of the number and variety of factors involved, and there is a danger in comparing the rates for particular services in isolation. Even a comparison of rates for several services will not necessarily exemplify the whole. Certain private-line and local telephone rates in Canada are known to be lower than similar rates in the United States. The situation is further complicated by the existence in both countries of several different regulatory jurisdictions, whose concepts of cost allocation, revenue settlement, and

Table 10. Selected Long-Distance Telephone Rates (day, 3 min., station to station)[8]

Approx. Distance (Miles)	Canada	United States
25	$0.25—0.40	$0.25—0.48
75	0.55—0.90	0.45—0.81
200	0.85—1.55	0.60—1.20
400	1.60	0.85
700	1.95	1.05
1,000	2.25	1.15

[8] Source—Department of Communications and TCTS.

value of service may differ. Nevertheless, TCTS has provided some figures (Table 11) which show that since 1963 Canadian maximum long-distance rates have remained almost static, while a steady reduction has continued in the United States. It would seem, therefore, that there are grounds for a more detailed examination of this problem.

Table 11. Maximum Long Distance Rates (day, 3 min., station to station)[9]

	1959	1960	1963	1966	1970
Canada	$5.00	3.95	3.35	3.00	3.00
United States	2.50	2.25	—	2.00	1.70
United States (DDD)	—	—	—	—	1.35

[9]Source—TCTS.

Possible Improvements in Regulatory Structure and Methods

The attempt to find satisfactory solutions to the problems of regulating telecommunications in Canada is rather like trying to shake hands with an octopus; for every promising tentacle that is hesitatingly grasped, there are seven others groping around. Almost any proposal that can be imagined has inherent disadvantages, while some of those put forward by participants in the Telecommission studies are unrealistic; it was recommended, for example, that the federal Government should immediately assume authority over all telecommunications in Canada, without regard for the constitutional implications.

A more practical suggestion, which might be justifiable under the terms of the constitution, was that all interprovincial rates should be subject to regulation by the CTC, leaving approval of intra-provincial rates to be delegated to provincial regulatory bodies. This would enable the federal regulatory body to examine issues of common concern, so as to develop and express the national outlook which most participants in the Telecommission studies believed to be necessary but lacking at present.

It has been pointed out, however, that experience of a two-tier regulatory system in the United States (where AT&T long-line tolls are subject to FCC approval and other telephone rates are under State jurisdiction) has not been encouraging. The history of telecommunications regulation in the United States and its relevance to the situation in Canada are the subject of an exhaustive study by Professor Dallas Smythe[10]. His report shows that federal and State regulation of telecommunications services has developed as a passive review function of the pricing structure, with system-wide aver-

[10] Telecommission Study 1(e).

aging of costs and prices and a case-by-case review of problems as they arise. Only about one-fourth of the activities of the telephone industry in the United States is under federal jurisdiction, although the Bell System provides 85 per cent of all local telephones and 90 per cent of all long-distance service. Professor Smythe observes that:

> The system-wide averaging of costs and revenues, linked with the arbitrary separation of investment and costs between the interstate and intrastate jurisdictions has produced a rate structure in which any correspondence between costs and rates is accidental and unintentional.

Only three or four of the State utilities commissions have given more than superficial attention to telecommunications, and the promulgation of standards for minimum service has been rare. Concern with the level of rates has not extended to an interest in rate-structure or the reduction of rates to the lowest level that would yield a fair return. Instead, according to Professor Smythe, attention has been centred on determining and preserving the value of utility properties. Nevertheless, in Canada, with a much smaller number of regulatory bodies, it is quite possible that some workable and advantageous arrangement could perhaps be arrived at through federal/provincial consultation and agreement.

An alternative way of influencing long-haul telephone rates throughout Canada is presented by the wide distances separating the telephone companies subject to regulation by the CTC, which also has regulatory authority over the coast-to-coast facilities of CN/CPT. Sub-section 380 (12) of the Railway Act provides that CTC approval is necessary for:

> "All contracts, agreements and arrangements between the company and any other company, or any province, municipality or corporation having authority to construct or operate a telegraph or telephone system or line, whether such authority is derived from the Parliament of Canada or otherwise, for the regulation and interchange of telegraph or telephone messages or service passing to and from their respective telegraph or telephone systems and lines, or for the division or apportionment of telegraph or telephone tolls, or generally in relation to the management, working or operation of their respective telegraph or telephone systems or lines, or any of them, or any part thereof, or of any other systems or lines operated in connection with them or either of them."

A TCTS opinion already quoted[11], with which some other participants concur, is that the authority of the CTC over the telephone companies under its jurisdiction enables the Commission, in effect, to insist on approving rates and revenue separations for interprovincial traffic between British Columbia and Ontario, between Ontario and parts of Newfoundland, between all parts of Canada and the Yukon and Northwest Territories, and—within Quebec—from the westerly borders of the Province to the Gaspé Peninsula. The exer-

[11] See Chapter 18.

cise of this authority would have the effect of establishing a coast-to-coast framework of long-haul rates to which other intermediate rates would gradually become adjusted. Furthermore, the powers of the CTC under sub-section 380 (12) of the Railway Act could be used indirectly to promote coordination and standardization of matters other than rate-setting and revenue-separations.

An outstanding impression left by the Telecommission studies dealing with regulatory matters is that the establishment of some mechanism for consultation and cooperation between federal and provincial regulatory bodies appears to be highly desirable. TCTS has suggested the formation of a 'National Association of Regulatory Authorities', consisting of delegates from federal and provincial regulatory bodies, to consult on matters of rates and service, and on national and provincial objectives, taking regional differences and requirements into account, TCTS also suggests a 'National Telecommunications Advisory Council', to work in parallel with the proposed Association, which would serve as a consultative body in the development of policy; the membership proposed would include government and industry representatives. Another possibility is that provision might be made for joint sessions of provincial regulatory authorities, with each other or with the federal body, at which matters of mutual interest could be fully examined; TCTS suggests that interprovincial rates might be approved at such joint sessions.

Another matter that might be the subject of discussion between governments is the authorization of new entrants into the provision of services falling within, or impinging upon, those segments of telecommunications that are operated, in the public interest, under conditions of monopoly or oligopoly. Since almost all telecommunications systems make some use of radiocommunications, the Radio Act affords some limited means of coordination, particularly when microwave systems are to be employed. But, since the operating areas of telecommunications undertakings do not always coincide with political or regulatory divisions, there is a danger that a new system might be authorized by one regulatory authority which, by taking traffic away from the public network of another undertaking, could increase the price paid for other services by the general public. One suggestion for dealing with the problem of new entrants is that principles should be defined, in appropriate federal and provincial legislation, for the guidance of regulatory bodies in determining the balance of the public interest. This would afford an opportunity for federal/provincial or interprovincial consultation in cases where the decision of one regulatory body might have an impact on the policies of another.

In general, Canadian regulatory bodies have been granted wide powers to enable them to ensure that rates are just and reasonable, and that the

carriers can count on a fair return on investment. In practice, these powers often amount to an authority to inquire into any relevant matter, including operating revenues and expenses, construction expenditures, depreciation practices, pension and stock plans, capital structure, and the level of productivity. However, a careful distinction must be drawn between an authority to inquire, a right of approval, and a power of direction. In framing new legislation, it might be pertinent to consider which of these kinds of authority should apply to each of the features of company activity that have been listed above, and perhaps to some others as well.

Attention has been drawn by TCTS to what it regards as a defect in the present regulatory system:

> "The basic nature of the quasi-judicial regulatory process, particularly in matters such as rate hearings, leads to delay, despite the best efforts of all parties and of the regulatory authority itself to proceed with despatch. This creates a particular problem for the carriers in an inflationary environment. Unfortunately, recognizing this defect does not lead to a simple solution. As with procedure in the ordinary courts, it is necessary, if justice is to be done, to enable both utility and other interested parties to be heard. Further, the preparation and subsequent evaluation of the detailed financial reports necessary to allow the regulatory authority to fully understand the carriers' financial position contribute to the delay. Efforts should be made to find means of speeding up the process. It may be that a continuing system of financial reporting and evaluation, supplemented by informal discussion, would result in the regulatory authority having a more complete understanding of the carriers' financial position at all times and expedite matters at rate hearings."

Several other participants have suggested that consideration be given to this idea of continuous surveillance, which might establish some justification for empowering the regulatory authority to give decisions on some matters, falling within limited classes specified in the legislation, without going to the expense of a full public hearing but with suitable provisions for appeal.

Another means of expediting the procedures for public hearings is to provide for mini-hearings to be held by a few members of the board of the regulatory authority. It is important not to confuse hearings with judgments; decisions are not normally made during the course of hearings, and provision could be made for judgments to be given by the regulatory body as a whole in the light of the evidence given at a mini-hearing.

There appears to be some danger in adopting a too meticulous approach to regulatory legislation. If an attempt is made to establish statutory criteria governing every conceivable aspect of the public interest in telecommunications, the outcome may be disappointing. Perhaps the most likely result would be the creation of administrative machinery so ponderous as to bring both regulator and regulated almost to a halt. At the very least, there is a danger that excessively prescriptive legislation may impel

the regulatory body to concern itself, or even interfere with, matters that more properly fall within the responsibilities of management.

A more flexible situation can be created by legislation giving the regulatory authority wide discretionary powers to regulate the industry in such a way as to promote the achievement of general policy objectives set out in the law. A principal purpose of setting up a regulatory authority in the form of a quasi-judicial tribunal is to ensure that decisions are entrusted to a body that is free from partisan influences. Consideration may be given, however, to the fact that the members of such a tribunal may also be better qualified than anybody else to act, on behalf of the Government, in certain matters associated with but not part of the regulatory process, and for which the determination of the public interest may be assigned by Parliament to the Government rather than to the regulatory body. An example is to be found in the Broadcasting Act, which reserves certain strictly limited powers to the Governor in Council. Similar considerations may apply to the drafting of legislation governing the regulation of telecommunications, for while it may be desirable to delegate complete authority over questions directly pertinent to the matter in hand, it is not always necessary to throw the baby out with the bath water.

The foregoing discussion has dealt in general terms with considerations affecting the objects and powers that might commend themselves to any Canadian government in formulating legislative policy for the regulation of telecommunications. The Government of Canada may also wish to give some thought to the reconstitution of the three existing regulatory bodies in the federal area of jurisdiction. The Canadian Transport Commission (CTC) has, as only one of its many responsibilities, regulatory authority over the telecommunications carriers. The Minister of Communications is, in effect, the regulatory authority for all radiocommunications, including the technical aspects of broadcasting. The Canadian Radio-Television Commission (CRTC) is empowered to regulate all other features of the Canadian broadcasting system. As mentioned above, the Minister of Communications is the spokesman in Parliament for the CTC in matters affecting communications, while other aspects of CTC affairs are spoken for by the Minister of Transport. The Secretary of State is the spokesman in Parliament for broadcasting matters.

One possible course of action would be to make no change in these arrangements, while at the same time recasting the legislation under which the CTC exercises its authority over the telecommunications carriers. A decision to maintain the links between transport and telecommunications in the federal regulatory body needs to be considered against the background of the differences in public policy and regulatory requirements in these two areas.

A second option would be to relieve the CTC of those responsibilities, and to assign whatever new regulatory powers may be devised to a separate body, which would be entirely dedicated to the regulation of communica-

tions, and might perhaps be called the Canadian Communications Commission. It should be pointed out, however, that the creation of a new body of this kind entails new overhead expenditures which might be diminished by some other approach. An important factor in this regard would be the additional work that might arise from any extension of regulatory authority over and above that now exercised by the CTC.

A third suggestion was that the regulatory authority over the telecommunications carriers might be transferred from the CTC to the CRTC. Under this arrangement, perhaps the membership and undoubtedly the staff of the CRTC would have to be expanded, but the additional recurring overhead expenses would be less than those of a separate newly-created body. The principal advantage, however, would be that the relationships between telecommunications carriers and broadcasters, including the ambivalent characteristics of CATV systems, could more easily be placed in perspective by a single regulatory body.

Finally, whichever of these solutions may commend itself, a remaining point for consideration is the proper location of authority for management of the radio-frequency spectrum. At present, radio licences are issued by the Minister of Communications at his own discretion. To the extent that frequencies are in abundant supply and no economic problems of competition are involved, few questions are likely to arise about the issue of licences to applicants for frequencies in the same band. Nevertheless, it might be desirable to provide for some form of impartial hearing in situations where there is a dispute about the application of federal rules, or where all demands cannot be met. The Minister might, for example, be authorized or, for certain specified matters, required to refer the subject of a forthcoming decision to the regulatory body, either for advice or for a decision. There is also perhaps room for productive collaboration with provincial authorities with regard to regional allocations of the radio-frequency spectrum.

However, the actual management of the radio-frequency spectrum is arguably a matter that should lie entirely within the authority of the executive arm of government. Obligations under international agreements must be honoured and, above all, the management of the spectrum is perhaps the most effective tool available to the Minister of Communications in fulfilling his statutory responsibility, which may require ministerial dealings with the Governments of the Provinces and other federal departments of a kind that could not be delegated to an autonomous body, to "promote the establishment, development and efficiency of communications systems and facilities for Canada."

RSVP

The Telecommission studies on which this Report is based were organized in a format intended to incorporate the advantages of both a public commission and a government study. The response to the invitation issued by the Minister of Communications was impressive, and an incalculable amount of effort was contributed voluntarily by a wide variety of interested organisms and people. The organization of the studies was entrusted to officials of the Government of Canada who, with very few exceptions, also had to contend with their normally full-time jobs.

The outcome, in quantitative terms, amounted to some 8,000 pages of background material packed with facts, forecasts, opinions, arguments, refutations, suggestions, recommendations, and—inevitably—a certain amount of nonsense. It is unlikely that any participant could be found who did not, while making his contribution, learn something he did not know before. Whether the enterprise was successful in achieving its objectives is for others to judge, but it can hardly be doubted that the resultant spread and accumulation of knowledge about the complex problems of telecommunications in Canada is likely to be beneficial.

Some important themes recurred throughout the course of the studies. Most important, perhaps was the insistence that communications are of the people, by the people, and for the people. If it be accepted that there is a 'right to communicate', all Canadians are entitled to it. New systems, new services that are coming into use today, and others that can be foreseen during the next decade or two, can be harnessed, given the will and the purpose, to provide new opportunities, new alternatives, and new and more satisfying ways of life and habits of mind.

Already it has become almost a *cliché* to say that humanity is in the throes of an intellectual revolution more profound than that induced by the invention of movable type and the printing press. The growing complexity of interdependence between people, groups, industry, academe, communities, and governments is increasingly reliant on the transfer of information on a scale that is beyond the capacity of existing resources. Today, the avalanche of written communications is creating exponentially growing mountains of records which consume, by their mere existence, expenditures of time and material resources that are disproportionate to their importance.

What is worse is that the transfer and storage of information in written form is beginning to defeat its own purpose. Information, properly organized, is the foundation of knowledge, and knowledge itself is not only a source of power but the key to understanding; today, however, information is more abundant than ever before but is in a state of chaos that defies analysis and correlation, and may be responsible for some of the sense of insecurity and discontinuity that is so manifest in all parts of the world.

The information systems of the future are already appearing in embryonic form for use in research, business, industry, defence, and government. The conjoint technology of communications and computers promises the development, probably before the end of the 20th century, of information systems that may to some extent replace paper and its storage, and will partly replace or transform methods of administration, book-keeping and clerical services, postal operations, publishing, banking, transportation, modes of entertainment, and the means for their enjoyment.

Already, most people in Canada enjoy telecommunications services that can be matched for efficiency and economy in very few other countries. But to say 'most people' implies that there are others, who benefit less or even perhaps not at all. These others are often statistically interred in residual percentages. To say that 99 per cent of Canadians have access to this or that service sounds very impressive, but it obscures the inference that there are more than 200,000 less fortunate Canadians who may be paying for the service, in one way or another, but not getting it. Thus, a desirable objective of Canadian telecommunications policy might be to ensure access to telecommunications services for the largest feasible number of Canadians on an equitable basis.

In the North, in the hinterlands and remote rural areas, some Canadians cannot send or receive information at all. For them, well intentioned and necessary progress planned by outsiders sometimes has unforeseen side-effects; on the coast of Labrador, for instance, where everybody used to be hooked in to a single party line, the gratefully accepted boon of a normal telephone system destroyed the principal source of local news and gossip. Satellite communications, in which Canada is taking a leading part, will ultimately enable isolated communities and people to communicate not only with the 'outside' but with each other, and will help to extend future computer/communications networks not only from one coast of Canada to another but to all three.

In the cities, congestion and transportation problems may be eased by new telecommunications facilities, with the prospect of more leisure and the means for its enjoyment. But, as in Labrador, urban progress may entail results that detract from its advantages in ways that become apparent only after damage has been done; those who plan new urban systems must somehow be made aware of what people want and how badly they want it. And, no matter what people want, without orderly planning the vision may turn into a nightmare, the Wired City into an electronic spaghetti factory.

The objective of universal access to telecommunications for all Canadians entails considerations extending beyond technology into economy, for access may be nugatory if it is inequitably priced. When services can be

most conveniently and economically provided by one or a few suppliers, prices must be just and reasonable, a condition that calls for public regulation of the industry. The regulation of rates for telecommunication services is no simple matter. For 70 years or more, regulators and regulated have been grappling with the problem of identifying the true cost of each service, for without this knowledge the balance of justice and reason, as it applies both to the public and the carriers, is even harder to determine. Here again, technology will help, for computers can do much that could not be done with a quill pen in a brass-bound ledger. In Canada, where the legislative authority for regulation of telecommunications undertakings is divided between Parliament and the provincial legislatures, there is room for new modes of consultation and collaboration between the federal and provincial governments and regulatory bodies with the object of co-ordinating local, provincial, and regional needs and services into plans and performance that will serve the interests of Canadian sovereignty, unity, social well-being, economic prosperity, and survival.

If these objectives are to be achieved, plans and money will be needed. The plans should be dictated by the needs of the people, and all Canadian governments, federal, provincial, and local, as representatives of the people, therefore have an interest in them and in their implementation. Plans that seem best suited to local or regional needs, regarded in isolation, may turn out to be far less than ideal if they fail to 'home in' with the plans of the neighbours. The potential utility of telecommunications systems or devices may be jeopardized if they cannot be interconnected with similar systems and devices elsewhere, so as to permit the maximum facilities for intercommunication. Consultation and agreement are likely to be more productive than confrontation if the interests that each government represents are to be accommodated to an all-Canadian perspective.

Plans suited to the people must also take account of existing telecommunications facilities which, although far from ideally designed for the information systems of the future, represent a colossal investment that cannot be instantly written off. The Canadian network of telecommunications systems—its telephones, teletypes, central offices, switching equipment, and transmission circuits—has a replacement value of around $8 billion today. The transformation into the information systems of the future will be an immense undertaking, possible in Canada only because the launching platform exists, uniquely, in domestic telecommunications research, manufacturing capacity, and operational expertise. There, and only there, Canada has the resources, if they can be rationalized, to go it alone in contemporary conditions of innovation, production, marketing, and international competition. For Canada to 'go it alone' does not, however, imply an abandonment of international commitments and assistance to other countries, but rather

an enlargement of capability and influence in a field where Canada is already a leader.

How much will it cost? What can Canadians afford? Neither of these questions can be answered definitively until there is agreement on the objectives of telecommunications policy and the pace at which they might be achieved. What can be said with certainty is that their achievement will cost more and take longer if there is unnecessary duplication of facilities, or if scarce resources—radio-frequencies, investment capital, research facilities, and professional manpower—are used to less than their best effect. What Canadians can afford to spend on telecommunications facilities is a matter that calls for reasoned decisions on relative priorities between social amenities as disparate as apples and bananas—expressways or two-way broadcasting, a computer console in every home or a chicken in every pot, wider educational opportunity or a good five-cent cigar.

It is perhaps easier to guess at what Canadians cannot afford. They cannot afford telecommunications designed yesterday, they cannot afford to let Canada become an information-satellite of the United States, they cannot afford to deny themselves the opportunity that developing technology affords to fashion for themselves a more spiritually and materially rewarding way of life. Above all, they cannot afford to wait and see how the information-revolution turns out; they must start planning and taking action now—not tomorrow but today. That is what the Telecommission studies were all about.

In all the information gathered, is there a single comprehensible message about the medium? The unequivocal answer is that there is. As telecommunications systems expand to provide a vastly increasing variety of services which may affect the whole quality of life in Canada, demand and expectations will grow, and there will be less and less tolerance of obstacles that impede access to new services. Canadians in urban and rural communities, and especially in the North and other remote areas, want access to more information—a demand that can be equated with access to telecommunications services—and they want it at the lowest feasible price. Equitably available communications are so fundamental to democracy that, time and again, participants in the Telecommission studies called for recognition of a 'right to communicate' as a fundamental objective of Canadian society. The subject dominated the seminars and conferences, and was raised in many of the individual studies. The accent is always on access.

The number and variety of proposals for achieving equitable access indicate the complexity of the problem, and no magical solutions are to be expected. Almost invariably, measures that would benefit one class of user may have serious implications for others. Better service in remote areas may mean higher prices in cities. Emphasis on an east-west flow of Canadian traffic may increase the price of local service. Computerized systems which

vastly facilitate access to organized information may also be a threat to personal privacy. Interconnection of private equipment with the switched networks, or competitive facilities for high-speed data-transmission, may benefit some users but adversely affect the price and quality of service for others. Thus, since most services are provided by a network of integrated systems, new offerings should be assessed in relation to the technical and economic viability of the whole, while the social impact of future telecommunications and information systems will call for the widest possible advance consultation about their purpose, planning, and use.

These considerations led to the view that those making decisions on fundamental issues of telecommunications policy should have access to all the relevant facts, and should be in a position to hear the views of all concerned so that the effects of their decisions may be seen in true perspective. Beyond the general need for consultation with industry and users, in Canada there appears to be a more specific need for consultation and co-operation between the federal and provincial governments and regulatory bodies. It was also suggested that there might be a more dynamic interaction between executive and regulatory organs of government, and that formal opportunities might be provided for the public to express its views on, or object to, proposed policies and regulations.

Finally, the significant opinion emerged that the beneficial development of telecommunications in Canada requires a clear statement of national policy dealing with the human and social values that underlie all aspects of government intervention in the provision of telecommunications services. The Government has announced its intention to table a White Paper on Communications Policy and may wish to take account of the objectives proposed by participants in the Telecommission studies. Among those on which great emphasis has been placed, in addition to equitable access at reasonable rates, are an early improvement of service in rural areas and the North, maintenance of an east-west axis for Canadian traffic, safeguards against invasion of privacy, Canadian control of telecommunications facilities and computer-utilities, and the expansion of telecommunications and data-processing research and manufacturing capacity in Canada. The challenge was pinned down by the Honourable Eric Kierans, Minister of Communications, in an address to the Canadian Broadcasting League; he said:

> "If our policies are to fulfil the promise of the technology, the promise of a better and more equitable distribution of information power, public policies must look beyond artificial boundaries, vested interests, and specialized knowledge. If our policies are to succeed, if they are to correspond to the needs of the people of Canada, we must have the courage to accept new facts, and to bring these facts together in a coherent and flexible policy."

APPENDIX A

Telecommission General Committee

	Chairman	Allan Gotlieb, *Deputy Minister of Communications*
	Vice-Chairman	Gilles Bergeron, *Assistant Deputy Minister (Operations),* *Department of Communications*
Canadian Broadcasting Corporation		J. P. Gilmore, *Vice-President, Planning*
		Spencer Moore, *International Liaison Officer (alternate)*
Canadian Radio Television Commission		R. Chiasson, *Co-ordinator of Research and Planning Branch*
		J. Miedzinski, *Consultant*
		J. Hylton, *General Counsel*
Canadian Transport Commission		G. F. Lafferty, *Commissioner*
		J. Hanley, *Director, Traffic Branch (alternate)*
Department of:		
	Communications	Richard Gwyn, *Executive Assistant to the Minister*
		Henry Hindley, *Executive Director & Secretary, Telecommission*
		de Montigny Marchand, *Research Director & Co-Secretary, Telecommission*
		Helen Wilson, *Assistant Secretary, Telecommission*
	External Affairs	R. A. Reynolds, *Head, Transport Communications & Energy Division*
		D. F. Fulford, *Deputy Head (alternate)*

Department of:		
Industry, Trade & Commerce		R. G. Head, *Assistant Deputy Minister (Operations)*
		E. A. Booth, *General Director, Electrical & Electronics Branch (alternate)*
	Justice	E. R. Olson, *Director, Legal Research and Planning*
	Transport	H. J. Williamson, *Director, Telecommunications & Electronics Branch*
	the Secretary of State	A. Fortier, *Assistant Under-Secretary of State*
		Mark McClung (*alternate*)
	the Solicitor General	B. C. Hofley, *Assistant Deputy Solicitor General*
National Film Board		G. G. Graham, *Director of Planning and Research*
		M. A. Martin, *Director, Ottawa Branch (alternate)*
Privy Council Office		Paul Tessier, *Assistant Secretary to the Cabinet*
Telesat Canada		J.-C. Delorme, *Vice-President, Administration*
	Secretary	C. McGee, *Department of Communications*

APPENDIX B

List of Telecommission Studies

I LEGAL CONSIDERATIONS

1(a) An Analysis of the Constitutional and Legal Basis for the Regulation of Telecommunications in Canada.
Submissions: Canadian Association of Broadcasters
Trans-Canada Telephone System
Consultant: Professor C. H. McNairn, University of Toronto.

1(b) History of Regulation and Current Regulatory Setting.
Report prepared by the Trans-Canada Telephone System. Contribution from the Province of Ontario included as an Annex to the report.

1(c) Concept of a Telecommunications Carrier.
Submissions: Province of Alberta
Canadian Association of Broadcasters
Canadian Cable Television Association
Canadian National/Canadian Pacific Telecommunications
Telesat Canada
Trans-Canada Telephone System

1(d) Analysis of Relationships Between the Functions of the Common-carriers and Those Engaged in Broadcasting.
Submissions: Canadian Association of Broadcasters
Canadian Broadcasting Corporation
Canadian Cable Television Association
Canadian National/Canadian Pacific Telecommunications
Electronic Industries Association of Canada
Telesat Canada
Trans-Canada Telephone System

1(e) The Relevance of United States Legislative-Regulatory Experience to the Canadian Telecommunications Situation.
Report prepared by Professor Dallas Smythe, University of Saskatchewan.

1(f) Relevance of Regulatory Experience in Countries Other than Canada.

II ECONOMIC CONSIDERATIONS

2(a) The Canadian Telecommunications Industry: Structure and Regulation.
Report prepared by Professor W. D. Gainer, University of Alberta.

2(b)(i) Communications in Canada: A Statistical Summary.
Report prepared by the University of Toronto (Professor A. R. Dobell).

2(b)(ii) Household Demand for Telecommunications Services—A Projection to 1980.
Report prepared by Professor L. I. Bakony, University of Victoria.

2(c) Spectrum Management: An Integrated Model of Management Alternatives and their Economic Implications.
Report prepared by the Centre for Applied Research and Engineering Design Incorporated of McMaster University.
Submission: Trans-Canada Telephone System.

2(d) Communications and Regional Development.

2(e) Telecommunications Carriers Market Projection and Analysis.
Report prepared by the Trans-Canada Telephone System and Canadian National/Canadian Pacific Telecommunications.

2(f) Corporate Ownership and Integration in the Telecommunications Industry.
Submission: Canadian Association of Broadcasters.

2(g) Description of the Canadian Telecommunications Manufacturing Industry.

2(h) Re-appraisal of the Present Management of the Radio Spectrum.
Report prepared by the Canadian Radio Technical Planning Board.
Submissions: Airtel Limited
Air Transport Association of Canada
Association of Municipal Electrical Utilities of Ontario
Calgary Power Limited
Canadian Association of Broadcasters
Canadian Broadcasting Corporation
Canadian Cable Television Association
Canadian Division, American Radio Relay League
Canadian Electrical Association
Canadian Gas Association
Canadian National Telecommunications
Canadian Pacific Telecommunications

Canadian Petroleum Association
Canadian Trucking Association
Council of Forest Industries of British Columbia
Department of National Defence
Department of Transport
Electronics Industries Association of Canada
Forest Protection Association
Imperial Oil Limited
International Nickel
Lenkurt Electric Company of Canada
Multitone Electronics Limited
Ontario Department of Education
Prince George Pulp and Paper
Province of Saskatchewan, Department of National Resources
Radio Common Carriers Association of Canada
Railway Association of Canada
Ready Mix Concrete Association
S. Simpson Limited
Telephone Association of Canada
T M C (Canada) Limited
B. R. Tupper, Engineering Consultants

Note: The above submissions are included in Part II of the Canadian Radio Technical Planning Board report; (a limited number of copies of Part II are available at a cost of $40.00 each from the Board, 880 Lady Ellen Place, Ottawa, Ontario.)

2(i) Study of Institutional Structure of Telephone Operating Industries.

Report prepared by the Trans-Canada Telephone System.

III INTERNATIONAL CONSIDERATIONS

3(a) International Implications of Telecommunications: the Role of Canada in Intelsat and other Relevant International Organizations.

Submissions: Canadian Broadcasting Corporation
Canadian Overseas Telecommunication Corporation
Trans-Canada Telephone System/Telephone Association of Canada.

3(b) Communications and the Canadian Assistance Program for Developing Countries.

Submission: Trans-Canada Telephone System
Consultant: F. Goodship

3(c) International Legal Problems Concerning the Transfer and Storage of Information.

3(d) The International Role of Canadian Telecommunications Companies.

3(e) An Analysis of International Telecommunications Operations, and the Growth and Handling of International Traffic.

Submissions: Canadian National/Canadian Pacific Telecommunications
Canadian Overseas Telecommunication Corporation
Trans-Canada Telephone System/Telephone Association of Canada

Contributions: Commercial Cable Company
Electronic Industries Association of Canada
Western Union International Incorporated.

IV TECHNOLOGICAL STUDIES

4(a) The Future of Communications Technology.

Submission: Trans-Canada Telephone System.

4(b) Research and Development Policies and Programs.

Submissions: Association of the Scientific Engineering and Technological Community of Canada (SCITEC)
Bell Canada Limited
Canadian Manufacturers' Association, Research and Development Committee
Canadian Research Management Association
Dr. J. M. Daniels, University of Toronto
Department of Industry, Trade and Commerce
Electronic Industries Association of Canada
Northern Electric Company Limited
Trans-Canada Telephone System

V INFORMATION AND DATA SYSTEMS

5(a)(c)(d)(e) Policy Considerations with Respect to Computer Utilities.

Submissions: Responses to a widely distributed questionnaire have not been treated as briefs or submissions; a full list of respondents is included in the Study report.

Consultants: Professor D. D. Cowan, University of Waterloo
Dr. Richard W. Judy, University of Toronto
Professor H. Lawford, Queen's University
Lyman E. Richardson, President, T-Scan Limited
Professor L. Waverman, University of Toronto

5(b) Conference Report—Computers: Privacy and Freedom of Information.

5(f) Institutional Arrangements for Optimizing Developments of Databanks in the Public Interest.

Consultants: Professor J. Boucher, University of Montreal
Professor G. Forget, Laval University
Professor H. Lawford, Queen's University

5(g) Problems in Data Transfer with Particular Regard to Visual Data.
Report prepared by Kar Liang, National Film Board.

Submissions: Professor L. Mezei, University of Toronto
Trans-Canada Telephone System

VI TELECOMMUNICATIONS ENVIRONMENT

6(a) Seminar Report—Telecommunications and Participation.

6(b) Seminar Report—Access to Information.

6(c) Seminar Report—Telecommunications and the Arts.

6(d) Seminar Report—The Wired City.

VII TELECOMMUNICATIONS AND GOVERNMENT

7(a)(b) Regulatory Bodies: Structures and Roles.

Submissions: Canadian National/Canadian Pacific Telecommunications
Canadian Transport Commission
Trans-Canada Telephone System

Consultant: University of Ottawa (Professor J. G. Debanné).

7(c) Relationship Between Department of Communications and the Telecommunications Carriers.

Submissions: Canadian National/Canadian Pacific Telecommunications
Telesat Canada
Trans-Canada Telephone System

7(d) Relationship Between the Department of Communications and the Telecommunications Manufacturing Industry.

Submissions: Canadian Radio Technical Planning Board
Electronic Industries Association of Canada.

7(e) Multidisciplinary Manpower Project Report.

7(g) Emergency National Telecommunications.
(Confidential Report)

Submissions: Canadian Electrical Association
Canadian National/Canadian Pacific Telecommunications
Trans-Canada Telephone System

7(i) Postal Services and Telecommunications.

VIII SPECIAL STUDIES

8(a) Problems Relating to the Regulation of Private Line Services.

Submissions: Canadian National/Canadian Pacific Telecommunications
Trans-Canada Telephone System.

8(b)(i) Study of Interconnection of Private Telecommunications Systems with the Systems of the Telecommunication Common Carriers.

Report prepared by Acres Intertel Limited.

Submissions: Canadian Electrical Association
Trans-Canada Telephone System.

8(b)(ii) Interconnection Between TCTS and CN/CP Telecommunications.

Submissions: Canadian National/Canadian Pacific Telecommunications
Trans-Canada Telephone System

8(b)(iii) Problems Relating to the Interconnection of Terminal Devices with Common Carrier Provided Telecommunications.

Submissions: Canadian Association of Broadcasters
Canadian Electrical Association
Canadian Gas Association
Canadian Industrial Communications Assembly
Canadian National/Canadian Pacific Telecommunications
Electronic Industries Association of Canada
Northern Electric Company Limited
Trans-Canada Telephone System

8(c) Northern Communications.

(Note: The report on the Northern Communications Conference is included).

Submissions: Canadian Broadcasting Corporation
Farinon Electric
Memorial University of Newfoundland
Telesat Canada
Trans-Canada Telephone System

Consultant: Acres Intertel Limited.

8(d) Multiservice Cable Telecommunication Systems—The Wired City.

Submissions: Canadian Broadcasting Corporation
Canadian Cable Television Association
Canadian National/Canadian Pacific Telecommunications

Electronic Industries of Canada
Trans-Canada Telephone System
Consultant: University of Ottawa (Professor G. Glinski, Dr. M. Krieger and Dr. C. Lemyre).

General Submissions: British Columbia Hydro and Power Authority
Canadian Electrical Association
Commission Hydroélectrique de Québec
'edmonton telephones limited'
E D P Industries Limited
Ontario Hydro
Western Coded Television

Requests for copies of submissions other than those prepared by government consultants should be directed to the source.

INDEX

C

D

E

R

S

COVER DESIGN—CHARLES F. GAGNON INC., MONTREAL